SELECTED WATER RESOURCES ABSTRACTS

VOLUME 1, NUMBER 1
JANUARY 1968

Selected Water Resources Abstracts includes abstracts of current monographs, journal articles, translations, and reports. The contents of these documents cover the physical, life, and social science, as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water.

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SELECTED
WATER RESOURCES ABSTRACTS
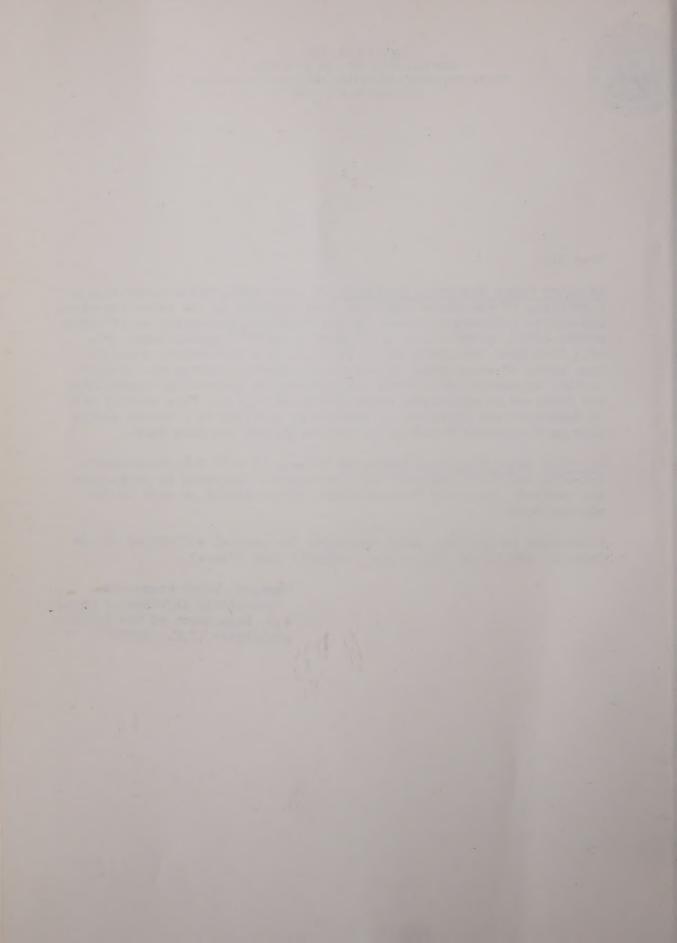
VOLUME 1. NUMBER 1
JANUARY 1968

Dear Sir:

Selected Water Resources Abstracts is a new publication comprising a reprinting of the cards that have been produced by the Water Resources Scientific Information Center in its selective dissemination of information (SDI) system which is designed to serve organizations. You will find that this publication is still in a rudimentary stage in many areas of water resource activity. However, during the coming months, we expect to increase its coverage as processing capabilities are acquired in additional water resources topics. This service will be augmented and improved and additional services will become available as the Center broadens its activities and its data base.

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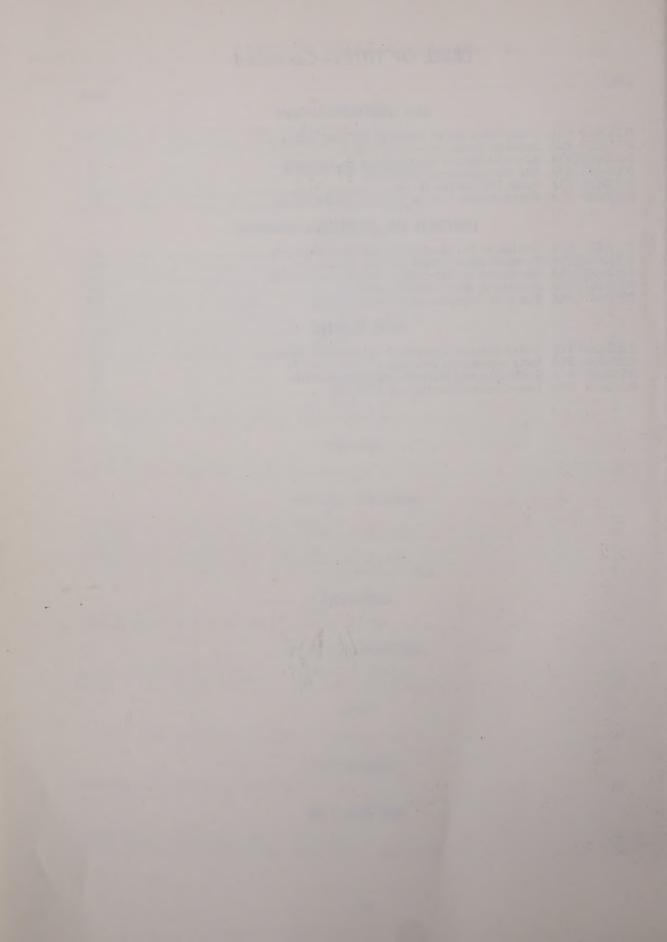Washington, D.C.   20240

TABLE OF TITLES

i

TABLE OF TITLES--Continued

TABLE OF TITLES--Continued

R202420X67A INDISPENSABILITY--A MANAGEMENT HAZARD

Most organizations have at least one executive who prides himself on being indispensable. He achieved this opinion of himself early in his career when he realized his abilities. On the assumption that his skills were unique, he built an organization around him to support his self-image. His organizational rules include: (1) all major decisions are made by him, (2) his ideas are the only important ones, and (3) his methods are to be used exclusively. His employees become increasingly dependent and security-minded, become yes-men and subordinate all their ideas and abilities, or become discouraged and resign. His practices affect his own professional growth, and he finds that he cannot advance without building a functionally independent team of workers. He must be convinced that his influence will be more persuasive as a coach and planner; getting out of his tightly controlled little circle can advance him to a more exciting career; and delegating responsibilities can attract and develop more efficient and creative people, who in turn will help him improve his status as an executive. The change cannot be expected overnight, for the process of reeducation is slow and requires time and patience; however, his abilities usually warrant the effort.

R202420X67A

R202481X67A PLANNING FOR REAL-TIME BUSINESS SYSTEMS

Systems planning, always important in computer system design, is even more important in real-time systems. For the optimum allocation of a company's resources, systems planning can be viewed as a management tool for exploiting new technological developments and introducing more complex systems. Systems planning is planning for systems rather than planning of particular systems; it embraces all areas of information processing technology, including equipment evaluation and selection, system design, programming, and computer operations. The modern systems planner should seek the answers to 3 basic questions: (1) what is the technology going to be like during the planning period, (2) what changes will take place in the organization's operating environment, and (3) what are the long-range corporate goals and objectives. In most progressive companies, systems planning is conducted on a formalized basis and integrated with corporate, budgetary, product, organizational, and personnel planning. The article concludes with a discussion of 11 guidelines for systems planning.

R202481X67A

R202410X67A SULFIDE STRESS CORROSION OF STEEL

No simple solution to the problem of sulfide stress corrosion has been
found nor is there universal agreement on the failure mechanism. Until the
mechanism of sulfide cracking is understood, development of resistant
alloys must be on an empirical basis. Many believe that cracking in an
aqueous hydrogen sulfide system is best explained by hydrogen embrittle-
ment; others believe that stress corrosion cracking is the predominant mode
of failure. The primary variables influencing hydrogen-induced delayed
failure in steel are strength level, stress level, and hydrogen content;
these factors also influence susceptibility to sulfide cracking. In gener-
al, resistance to cracking diminishes as strength increases, and normalized
or normalized and tempered steels are less resistant than quenched and tem-
pered steels. With the exception of carbon, changes in alloy content not
affecting microstructure have no influence on sulfide cracking. Small
changes in microstructure can profoundly change cracking resistance. Aus-
tenitic steels are more resistant than steels with body-centered struc-
tures; therefore, an increase in elements such as nickel and manganese
which lower the martensite transformation temperature and stabilize the
face-centered structure can be very beneficial. Has 26 references.

R202410X67A

R202445 67A REINFORCED CONCRETE PIPE DESIGN

The procedure for designing a reinforced concrete pipe installation is out-
lined. The author emphasizes that: (1) the ultimate 3-edge bearing test
strength has no meaning in terms of field performance, and (2) there is no
basis for translating results of the laboratory test into an ultimate
strength under field conditions. He recommends that the most appropriate
approach to design of a reinforced concrete pipe installation is to utilize
the 0.01-in. crack test strength (or some similar visible and measurable
indicator of early load effect) as a basis for selecting pipe strength and
specified bedding and backfilling requirements. An example of pipe culvert
design based on the 0.01-in. crack, 3-edge bearing strength is presented.
Behavior of a reinforced concrete pipe loaded by earth overburden is de-
scribed, and the reason for concrete spalling at the crown and invert is
presented. Repair methods which take advantage of passive soil pressures
at the sides of the pipe are described and examples given. A history of
the development of ASTM standard specifications for reinforced concrete
pipe is included.

R202445 67A

R202440X67A PRESTRESSED LIGHTWEIGHT CONCRETE

A discussion of prestressed lightweight concrete made with high-quality
structural lightweight aggregates such as expanded shales, clays, and
slates is presented. Capable of developing cube strengths from 280 to
500 kg/cu cm (4000 to 7000 psi) at unit weights of 1400 to 2000 kg/cu m
(85 to 120 pcf), this concrete has been used satisfactorily in factory
production of standardized structural elements and for individual major
structures requiring a high degree of technical performance and reliabil-
ity. Satisfactory values of shrinkage and creep are obtainable. Modulus
of elasticity is approximately half that of normal concrete at the same
strength. Fire resistance and thermal insulation are significantly better
than for normal weight concrete. Specific applications are listed, and
cement content, gross water requirement, unit weight, elasticity modulus,
creep, shrinkage, tensile strength, resistance to freezing and thawing,
fire resistance, rupture modulus, pullout bond strength, and ultimate
strain are discussed.

R202440X67A

R202460X67A FROZEN GROUND CONSTRUCTION TECHNIQUES

Artificially freezing unstable ground to sink a shaft was first tried in
Wales in 1862. Although the process is used mainly for sinking shafts, it
has been adapted for tunnel excavation through bad ground or running sand,
stabilizing embankments and excavations to prevent slides, and maintaining
frozen ground under heated buildings constructed on permafrost. In shaft
sinking, for example, vertical freeze-pipes, usually from 4 to 6 in. in
diameter, are placed about 4 ft apart in a circle outside the shaft area
and chilled brine is circulated in the pipes to extract heat from the
ground. Changing the pore-water to ice stabilizes the soil. Frozen soil
is not an elastic material, but creeps under steady load. Parameters are
temperature and time dependent. Strength computations are made assuming
plastic failure and Coulomb's law; deformation is computed separately for a
given time by means of the simplest possible creep equation. Principles of
design and refrigeration requirements are given. Gives 32 references.

R202460X67A

R202429 67A SPILLWAY AND STILLING BASIN DESIGN

Results of a study of spillways and stilling basins in Germany are report-
ed. The purpose of the study was to establish designs for improved econ-
omy, capacity, and efficiency of such structures. Improvement of spillway
intake capacity by installing tilted and enlarged pier noses is described.
The effects of guide walls on superelevated flow in curved spillway chutes
are discussed. Design criteria for shaped spillway crests and for side
walls with chutes carrying supercritical flow are given. Two types of
unconventional stilling basins are examined.

R202429 67A

Hartung, F and Knauss, J
DEVELOPMENTS TO IMPROVE ECONOMY, CAPACITY, AND EFFICIENCY OF STRUCTURES
CONTROLLING THE PASSAGE OF FLOOD WATER THROUGH RESERVOIRS. Paper, Proc,
9th ICOLD Conf, pp 227-249, Istanbul, Turkey, Sept 1967. Oskar v. Miller-
Inst, Obernach, West Germany, 23 p, 27 fig, 1 tab, 5 ref
DESCRIPTORS-- *spillways/ spillway crests/ spillway gates/ standing waves/
*stilling basins/ *discharge coefficients/ training walls/ piers/ *chutes/
hydraulics/ shock waves/ channels/ *energy dissipation/ hydraulic models/
baffles/ dentated sills/ Froude number/ model tests/ supercritical flow/
optimum design/ design/ efficiencies/ foreign design practices
IDENTIFIERS-- guide walls/ Germany/ pier noses

R202432X67A UPLIFT IN GRAVITY-TYPE DAMS

Available literature on the subject of uplift is critically reviewed. For
discussion purposes, uplift theories are divided into 2 groups: (1) those
assuming the action of uplift to be associated with the formation of visi-
ble or imaginary cracks, and (2) those characterized by assumed permeabil-
ity of uninjured masonry or concrete. The use of a coefficient of reduc-
tion, prevalent in the older theories, is discussed and discounted, and the
conclusion that uplift acts over 100% of the base area is justified. Char-
acteristics fundamental to the development of all modern mathematical theo-
ries on uplift are specified, and the relationship between uplift factor
and porosity coefficient is discussed. Leliavsky's laboratory method for
determining the effective superficial porosity of a material is described.
Various proposals for determining the magnitude of uplift in gravity dams
are critiqued. Has 17 references.

R202432X67A

Attri, Narinder S
UPLIFT IN GRAVITY TYPE DAMS
ASCE Proc, Jour Struc, Vol 93, No ST4, Paper 5377, pp 61-68, Aug 1967. The
Boeing Co, Renton, Wash, 8 p, 3 fig, 17 ref, append
DESCRIPTORS-- *uplift pressures/ underseepage/ flow nets/ *gravity dams/
*pore pressures/ *concrete dams/ porosity/ laminar flow/ pore water
pressures/ bibliographies/ hydrostatic pressures/ reviews/ theory/ seepage/
porous materials/ cutoffs/ drainage systems/ impervious blankets/ grout
curtains/ hydraulic gradients/ permeability
IDENTIFIERS-- uplift resistance

R202449 67A BAFFLE GATE FOR CLEANING SPAWNING CHANNEL

The Tehama-Colusa Canal in California is the first known dual-purpose canal
being used both as a salmon spawning grounds and a conveyance structure to
supply irrigation water. This study is concerned with cleaning deposited
sediment from the 2.5-ft-deep gravel spawning bed in the dual-purpose chan-
nel and related problems. Exploratory tests were made in a 2- x 2- x 8-ft-
long flume to determine which of various possible cleaning methods might be
successful. These preliminary tests considered underdrains, water and air
jets, a floating barge with and without underwater baffles, a mechanical
cleaning device, and a baffle gate by which the sediment was washed from
the gravel as the gravel was moved a short distance downstream. Based on
these tests, the baffle gate method was studied in detail in a larger flume
4 ft wide, 8 ft deep, and 80 ft long. Tests were made with prototype-size
gravel (3/4 to 6 in.) up to the depth and discharge capacity of the flume.
To test the full prototype depth, gravel sizes were reduced on a 1:2 scale.
Depth that the gravel would be scoured was related to 2 variables: posi-
tion of the baffle gate above the gravel and differential head across the
gate. Requirements for successful spawning by salmon are discussed and
hydraulic design criteria for the facility are included.

R202449 67A

Carlson, E J
BAFFLE GATE METHOD FOR CLEANING SALMON BEDS IN CANALS
Proc, 12th Cong of IAHR, Vol 3, pp 266-274, Fort Collins, Colo, Sept 1967.
Bureau of Reclamation, Denver, Colo, 9 p, 4 fig, 4 ref
DESCRIPTORS-- canals/ *irrigation canals/ *cleaning/ open channel flow/
trapezoidal channels/ *fish handling facilities/ fishways/ gravel blankets/
multiple purpose structures/ suspended sediments/ gravels/ tractive forces/
movable bed models/ gates/ baffles/ sediment control/ boundary shear/ fish/
velocity distribution/ laboratory tests/ scour/ irrigation O&M
IDENTIFIERS-- salmon/ *spawning channels/ Tehama-Colusa Canal, Calif/ redds

R202450 67A DROP STRUCTURES IN TRAPEZOIDAL CHANNELS

Hydraulic characteristics of flow over drop structures connecting 2 trape-
zoidal channels at different elevations are considered. The drop struc-
tures, some with weirs, and some without, are formed by an abrupt drop in
the horizontal channel bottom. Relationships among the quantities perti-
nent to the hydraulic characteristics were investigated through dimension-
al and experimental analyses. The dimensional analysis, based on theoret-
ical consideration of the flow problem, resulted in a set of dimensionless
parameters; namely, relative depth after hydraulic jump, drop number, and
geometrical parameters of the drop structure. Bottom width, side slope,
vertical drop, and weir height were varied systematically in the experi-
mental channels. Over 170 test runs were analyzed and are presented in
graphical form. Experimental data from other studies of flow over verti-
cal drops in rectangular channels are included to compare the effects of
trapezoidal and rectangular geometry on hydraulic characteristics.

R202450 67A

Shih, Cornelius C and Parsons, Donald F
SOME HYDRAULIC CHARACTERISTICS OF TRAPEZOIDAL DROP STRUCTURES
Proc, 12th Cong of IAHR, Vol 3, pp 249-259, Fort Collins, Colo, Sept 1967.
U of Alabama, Huntsville; FPC, Washington, D C, 11 p, 10 fig, 9 ref
DESCRIPTORS-- *drops /structures// *trapezoidal channels/ open channel
flow/ *hydraulic jumps/ weirs/ hydraulic models/ *dimensional analysis/
geometry/ cross sections/ fluid mechanics/ hydraulics/ energy dissipation/
*control structures/ baffles/ steady flow
IDENTIFIERS-- hydraulic design

R202452 67A SCOUR IN TAILWATER OF SHAFT SPILLWAYS

Results of laboratory investigations on the effect of macroturbulence
(velocity and pressure pulsation) in stilling basins and outlet channels
below shaft spillways are reported. Layouts of regulating structures con-
sidered include: (1) diverging channel section with baffle piers and baf-
fles, (2) rectangular section with baffle sill, (3) rectangular section
with baffles, and (4) jet impingement from a double conduit spillway.
Values are given for the pulsation coefficient of hydrodynamic loads acting
on the baffle piers and baffles under different conditions; relationships
to be used for determining slab thickness of basin and channel floors and
slopes for a double conduit spillway are presented. Charts of tailwater
bottom velocities required for predicting scour are included. Scour is
shown to be determined mainly by the actual bottom velocities, and an ap-
proximate method for forecasting depth of scoured holes is proposed.

R202452 67A

Rozanov, N P; Givotovsky, L S; Pashkov, N N
THE EFFECT OF MACROTURBULENCE IN THE TAILWATER OF TUBULAR SPILLWAYS ON
TAILWATER STRUCTURES AND LOCAL SCOURING. Proc, 12th Corg of IAHR, Vol 2,
pp 144-153, Fort Collins, Colo, Sept 1967. Kuibyshev Civ Engg Inst,
Moscow, USSR, 10 p, 6 fig, 11 ref
DESCRIPTORS-- turbulence/ *stilling basins/ *energy dissipation/ spillways/
*backwater/ model tests/ hydraulic models/ dentated sills/ hydraulic jumps/
baffles/ velocity/ velocity distribution/ discharges/ rectangular conduits/
*scour/ pipes/ submergence/ tailrace/ slabs/ slope protection/ *erosion/
laboratory tests
IDENTIFIERS-- *tailwater/ foreign research/ USSR/ macroturbulence

R202453 67A PRESSURE FLUCTUATIONS IN STILLING BASINS

Knowledge of the amplitude-frequency spectrum of pressure fluctuations
caused by turbulence in hydraulic structures allows determination of dy-
namic loading in structural design. Pilot studies into the use of elec-
tronic equipment in the analysis of random pressure fluctuations in models
of 2 distinct types of stilling basins are described. The models investi-
gated represented Morrow Point Dam with a free-fall spillway with impact-
type energy absorbing pool at the base of the dam and Crystal Dam outlet
works having a hydraulic jump stilling basin with a center wall separating
the jets from 2 high-pressure slide gates. Data from the 2 models showed
marked differences in the frequency spectra. The studies were restricted
to determining dynamic loads acting on the structures, without regard to
the dynamic response of the structures. The analyses described allow
solution to 2 problems encountered in the design of hydraulic structures:
(1) determination of stresses caused by the application of a periodic force
at a given frequency, such as the natural frequency of the structure; and
(2) determination of stresses resulting from the complete spectrum of
forces and frequencies under nonresonant conditions.

R202453 67A

King, D L
ANALYSIS OF RANDOM PRESSURE FLUCTUATIONS IN STILLING BASINS
Proc, 12th Cong of IAHR, Vol 2, pp 210-217, Fort Collins, Colo, Sept 1967.
Bureau of Reclamation, Denver, Colo, 8 p, 5 fig
DESCRIPTORS-- *stilling basins/ Fourier analysis/ *pressure distribution/
hydraulic structures/ structural design/ *live loads/ *spectrum analysis/
electronic equipment/ spectra/ model tests/ hydraulic models/ transducers/
frequency analyzers/ frequency/ stress analysis/ pressure measuring equip/
oscillographs
IDENTIFIERS-- Morrow Point Dam, Colo/ Crystal Dam, Colo/ *dynamic loads/
*amplitude

R202476X67A DJATILUHUR PROJECT

Construction of the Djatiluhur Project on the island of Java was completed
in 1967. The project provides irrigation, hydroelectric power, and flood
protection. Djatiluhur Dam is a 114.5-m-high rockfill dam with a compacted
earth core and is believed to be the largest in Southeast Asia. The reser-
voir covers 83 sq km and has a capacity of 3 billion cu m. An unusual fea-
ture is a circular concrete tower housing the powerplant and spillway. The
spillway has a capacity of 3000 cu m/sec, meeting estimated requirements
for passing the peak of a thousand-year flood. The power station has 6
31-mva generators and, in normal operation, a head of 48.5 to 80.5 m. Ge-
ography and geology of the area are outlined and noteworthy features of the
project, transmission lines, power station operation during floods, and
reservoir regulation are described briefly.

<div align="right">R202476X67A</div>

DESCRIPTORS-- foreign construction/ foreign design practices/ irrigation/
*foreign projects/ *hydroelectric powerplants/ flood peaks/ flood control/
spillways/ rock fills/ *multiple purpose projects/ reservoir operation/ dam
foundations// switchyards /electrical// engineering geology/ water quality/
safety
IDENTIFIERS-- Djatiluhur Project, Java/ Indonesia

R202444X67A DRILL RIG FOR DEEP DRAINAGE OF SLOPES

The best method for stabilizing landslides in Czechoslovakia is to drill
drainage bores with augers or core drilling equipment. Investigations were
conducted to find mobile-type equipment which could drill both vertical ex-
ploratory holes and inclined drainage bores. After a series of comparative
tests, the machine selected was the PZV rig made in Czechoslovakia. The
rig is mounted on the chassis of an extremely sturdy 12-ton cross-country
truck and has standard tooling for augering bores of 150-, 250-, and 480-mm
diameters; it can drill at any angle from the vertical to the horizontal
(pointing straight back along the axis of the truck) and between 40 deg off
vertical to the left and 100 deg off vertical to the right of the truck.
The machine was evaluated in exploratory as well as deep-drainage roles on
a site where comparable equipment previously had been used to prevent land-
slides. The performance of various drill rigs (all working under the same
geological and morphological conditions) is plotted for comparison and the
site preparation time required by these rigs compared.

<div align="right">R202444X67A</div>

DESCRIPTORS-- drainage systems/ *landslides/ soil stabilization/ *augers/
vertical drains/ *drilling equipment/ portable/ core drilling/ drill holes/
rotary drilling/ boreholes/ auger borings/ slopes/ drills/ variable-speed
drives/ casings/ *drilling/ subsurface investigations/ drainage/ plastic
tubing
IDENTIFIERS-- Czechoslovakia/ comparative studies/ polyvinyl chloride/
foreign research

DRAINAGE AND GROUND WATER

R202473 67A RAINFALL SEEPAGE AND DRAINAGE

The problem of steady rainfall seepage into soil lying above an impermeable
layer drained by ditches of unequal water level heights is investigated. A
theoretical solution and numerical results are presented for the case of
drainage ditches just reaching or penetrating into the impermeable layer.
The problem is solved by using a finite series of orthonormal functions
generated from products of trigonometric and hyperbolic functions. The
solution gives the potential function and stream function for a range of
water level heights, ditch spacings, and R/K ratios (rainfall rate R to
hydraulic conductivity K). If R/K is increased from 0 to 0.05 for ditches
spaced 10 m apart with 2 adjacent ditches maintaining water 1 and 1.5 m
above the barrier, the maximum water table height in the soil will increase
from 1.50 to 1.82 m. As R/K increases, the maximum water table elevation
will approach a position midway between the ditches. Flow nets and other
results computed for a number of geometries provide additional information.
Has 16 references.

R202473 67A

ELECTRIC POWER

R202416X67A ECONOMIC LOAD SCHEDULING

Economic load scheduling for multiplant power systems has received much
attention in the last 2 decades. Computers have been used to issue in-
structions to separate plants to adjust their outputs at regular intervals
for economical operation in accordance with system requirements. The sug-
gestion presented in this paper is an improvement on the existing method
for digital computation and results in a computing time reduction of
approximately 50 to 70% when economic load scheduling is based on total
generated power and 40 to 60% when based on total load. The proposed
method uses exact penalty factors and loss-formula coefficients and takes
the total generation or load requirements directly as input. An example
comparing existing and proposed methods for calculating load scheduling is
given, along with the computing times for each method.

R202416X67A

An independent organization tentatively named Electric Power Research and Development Center (EPRDC) is developing plans for a high-power, high-voltage, power system-based laboratory to be located at Grand Coulee, Wash. The proposed laboratory will be used by electric utility companies and educational institutions for research and development in the high-power, high-voltage transmission field. In conjunction with the laboratory, a graduate research center is proposed; it will be open to any university or college wishing to make use of the specialized facilities that will be available. Considerations involved in the preliminary design and advantages offered by such a comprehensive system-based laboratory are summarized. Existing high-power laboratories are reviewed, and EPRDC's objectives are outlined for this new facility. Site selection is discussed and reasons are given for proposing the Grand Coulee site. A description of the proposed laboratory and a block diagram showing its functional features are included.

R202425X67A

Szablya, J F and Lewis, W A
A COMPREHENSIVE HIGH POWER, HIGH VOLTAGE, POWER SYSTEM BASED LABORATORY
Paper 31 CP 67-539, IEEE Summer Pwr Mtg, Portland, Oreg, July 1967.
Washington State U, Pullman; Illinois Inst of Tech, Chicago, 16 p, 6 fig, 7 ref, 2 append
DESCRIPTORS-- *extra high voltage/ laboratories/ research and development/ *test facilities/ electrical industries/ transmission lines/ climatology/ *electric power// transmission /electrical// electric power production/ transportation/ costs/ electromagnetic properties/ automation/ education/ programs/ data collection systems/ data processing systems
IDENTIFIERS-- Coulee Dam, Wash/ operating costs/ site selection

R202426X67A COMPUTING TRANSMISSION SYSTEM RELIABILITY

A method of applying probability techniques to the analysis of transmission system reliability is presented. The method considers generation and transmission equipment performance, weather conditions, load cycles, generation dispatch, interconnections, and the effect of scheduled outages. A mathematical model has been developed to simulate the operation of a transmission system and to evaluate reliability. This model has been applied to study several specific portions of a system. Reliability of the transmission supply to several stations and reliability of the station supply to low-voltage buses are calculated. Included in the analysis is the effect on system reliability of performing scheduled outages according to certain specified policies.

R202426X67A

Mallard, Stephen A and Thomas, Virginia C
A METHOD FOR CALCULATING TRANSMISSION SYSTEM RELIABILITY
Paper 31 TP 67-501, IEEE Summer Pwr Mtg, Portland, Oreg, July 1967. Public Serv Elec & Gas Co, Newark, N J, 14 p, 6 fig, 5 tab, 8 ref
DESCRIPTORS-- *transmission /electrical// *reliability/ *systems analysis/ weather/ storms/ electrical equipment/ electric power failures/ *overloads/ electric power production/ maintenance/ mathematical analysis/ scheduling/ peak loads/ probability/ power system operations
IDENTIFIERS-- interconnected systems/ *outages/ mathematical models

R202427X67A NEW CONTROL SYSTEM FOR STATIC CONVERTERS

Static converters for hvdc transmission systems, based on mercury-arc
valves or thyristors, are controlled by accurately timed firing pulses
from a control system. The conventional control system has not been
practicable for operating converters on a very weak a-c system, primarily
because of harmonic instability caused by direct dependence of the control
system on a-c line voltage and its distortion. A phase-locked oscillator-
type pulse timing control system removes this direct dependence and makes
possible the operation of converters on weak a-c systems, without harmonic
instability. The basic principles of the system are described, discussed,
and compared with other types of systems. Performance of the phase-locked
oscillator control system under steady-state operation and effects of a-c
system transients are reported. The system has been tested extensively on
an hvdc simulator under conditions more stringent than on a real installa-
tion.

<div align="right">R202427X67A</div>

Ainsworth, J D
THE PHASE-LOCKED OSCILLATOR--A NEW CONTROL SYSTEM FOR CONTROLLED STATIC
CONVERTERS. Paper 31 TP 67-499, IEEE Summer Pwr Mtg, Portland, Oreg, July
1967. English Elec Co, Ltd, Stafford, G B, 9 p, 9 fig, 1 tab, 5 ref
DESCRIPTORS-- extra high voltage/ direct currents/ *rectifiers/ electric
power// *converters /electrical// control/ alternating currents/ mercury/
*inverters/ electric arcs/ electric potential/ *oscillators/ frequency//
filters /electromagnetic// attenuation/ transients/ amplifiers/ control
systems/ electrical equipment
IDENTIFIERS-- *electric converter valves/ foreign research/ Great Britain/
harmonics/ short circuits

R202446X67A GENERATOR EXCITATION AND POWER SYSTEMS

A general survey of the various ways in which electric power system opera-
tion is affected by automatic excitation control of generators, with spe-
cial emphasis on stability, is presented. Power system stability may be
affected by a wide array of other influences; however, only excitation
systems are discussed. Automatic voltage regulators, steady-state stabil-
ity with and without automatic voltage regulators, stability power limits
of long-distance transmission lines, excitation stabilizers, and influence
of excitation system characteristics on stability are examined. Excitation
system developments from 1946 to the present time are reviewed. Problems
relating to transient stability and steady-state stability are evaluated.
Special field tests on a cross-compound turbine-generator at the point of
instability are used as an illustration of instability. Stability in a
complex network has many aspects; however, the excitation system should be
capable of responding properly to each problem as it arises and effective-
ly damp all periods of oscillations which a generator may experience.

<div align="right">R202446X67A</div>

Concordia, C and Temoshok, M
GENERATOR EXCITATION SYSTEMS AND POWER SYSTEM PERFORMANCE
Paper 31 CP 67-536, IEEE Summer Pwr Mtg, Portland, Oreg, July 1967.
General Elec Co, Schenectady, N Y, 21 p, 13 fig, 1 tab, 5 ref
DESCRIPTORS-- *excitation/ *electrical stability/ *electric generators/
transmission lines/ extra long distance/ voltage regulators/ research and
development/ electric currents/ electric potential/ field tests/ computers/
*electrical networks/ electronic equipment/ characteristics/ simulation/
alternating currents/ automatic control/ *power system operations
IDENTIFIERS-- *transient stability/ excitation regulators/ dynamic
stability/ *power system stability

R202447X67A UNDERFREQUENCY RELAYS FOR LOAD SHEDDING

When insufficient generation is available to meet load during severe emergencies, an automatic load shedding program throughout the affected area can prevent total system collapse. Through such a program, restoration of all affected loads is accomplished faster. Factors involved in applying underfrequency relays to achieve a desired deficient generation protection level and a method of calculating optimum settings for underfrequency relays are described. The application in substations throughout the load area of underfrequency relays, preset to drop specific percentages of load at predetermined low system frequency values, provides the simplest automatic load shedding program. Relay settings can be developed to drop the minimum load to arrest system frequency decay at a safe operating level. Additional underfrequency relays can be applied to initiate a safe and orderly system separation or shutdown if the emergency is beyond the capabilities of the load shedding program. Calculating procedures and sample calculations for relay setting coordination are given.

R202447X67A

Lokay, H E and Burtnyk, V
APPLICATION OF UNDERFREQUENCY RELAYS FOR AUTOMATIC LOAD SHEDDING
Paper 31 TP 67-447, IEEE Summer Pwr Mtg, Portland, Oreg, July 1967.
Westinghouse Elec Corp, East Pittsburgh, Pa, 10 p, 10 fig, 6 ref, 3 append
DESCRIPTORS-- *electric relays/ *frequency shifts/ overloads/ electrical
engineering// failure /power// mathematical analysis/ electric power/ speed
regulators/ *disturbances/ electric power production/ characteristics/
calculations/ coordination/ electrical stability/ *power system operations/
operations/ optimum design
IDENTIFIERS-- interconnected systems// *protection /electrical// tie lines/
spinning reserve/ *load shedding/ governors

R202448X67A PHASE-COMPARISON RELAYING FOR EHV LINES

Phase-comparison protection provides high-speed simultaneous fault clearing of all line terminals by utilizing a communications channel to compare the current phase positions at the ends of the line. Newly developed solid-state schemes applicable to long ehv lines with series capacitors are described. An improved sequence current filter converts the 3-phase line currents to 2 single-phase voltages; the voltage for phase comparison is a function of all 3 symmetrical components, while the second voltage output, insensitive to positive-sequence current, actuates a fault detector circuit. For the first time, digital logic circuits are using a frequency shift channel to allow phase comparison on both half cycles to minimize trip time. This dual-comparer principle is applicable to either a transfer-trip or power-line-carrier-blocking scheme. An improved all-static relaying scheme for ehv systems with series capacitors is described. This scheme uses the phase-comparison technique to solve the negative reactance problem introduced by series capacitors. A historical review of developments in the evolution of the phase-comparison principle is given.

R202448X67A

Rockefeller, G D
PHASE-COMPARISON RELAYING FOR EHV LINES
Paper 31 CP 67-458, IEEE Summer Pwr Mtg, Portland, Oreg, July 1967.
Westinghouse Elec Corp, Newark, N J, 10 p, 10 fig, 2 tab
DESCRIPTORS-- *electric relays/ *extra high voltage/ frequency shifts/
electric power/ alternating currents/ electric potential/ power system
operations/ powerline carriers/ electrical stability/ solid state physics/
capacitors/ capacitance// faults /electrical// communications/ attenuation/
electromagnetic shielding/ microwaves/ rectifiers/ amplifiers/ electrical
equipment/ *transmission lines/ phase control
IDENTIFIERS-- *protection /electrical// transfer tripping/ reactance

R202475X67A TRANSMISSION LINE TOWER ARRANGEMENT

A dynamic computer programming procedure to select sites and heights of
towers in an overhead electric power transmission line is described. Use
of this procedure minimizes construction costs, yet satisfies physical con-
straints. Once the route for a transmission line has been established and
divided into straight sections, assuming that tension towers are fixed at
each end, the procedure analyzes each straight section to determine the
most economical spacing, height, and location for suspension towers. The
procedure was applied to a stretch of 275-kv line, 10,975 feet long;
results compared favorably to those obtained by current practice implement-
ed on the line. Several possible extensions of the method are suggested.

R202475X67A

Ranyard, J C and Wren, A
THE OPTIMUM ARRANGEMENT OF TOWERS IN AN ELECTRIC POWER TRANSMISSION LINE
The Computer Jour, Vol 10, No 2, pp 157-161, Aug 1967. U of Leeds, G B,
5 p, 1 fig, 5 ref
DESCRIPTORS-- *transmission towers/ *transmission lines/ electric cables/
*computer programming/ *locations/ spans/ structural engineering/ tension/
clearances/ terrain/ cost comparisons/ electric power/ electrical
engineering/ foreign design practices/ computers
IDENTIFIERS-- *computer tower position/ comparative studies/ Great Britain/
electric conductors

R202477X67A SIMPLIFIED LOAD FLOW

A simplified load flow program for use on a digital computer provides a
solution to real power network flow with a high degree of accuracy and
reduced computer running time. The program is designed to analyze real and
reactive power flow simultaneously and provide system voltage control by
load tap changing transformers or varying reactive output of system genera-
tors. The program explores and develops transmission associated with fu-
ture generating capacity on complex a-c power network systems and supplies
power flow answers in mw for a given system with a high degree of accuracy,
with much less running time and considerably less input data than is re-
quired for an a-c load flow program. The program, as outlined, is capable
of solving a network system of 360 buses and 585 lines. A computer flow
diagram and a single-line representation of a 21-bus test system is given.

R202477X67A

Bonaparte, J E and Maslin, W W
SIMPLIFIED LOAD FLOW
Paper, IEEE 1967 PICA Conf Record, pp 385-394, Pittsburgh, Pa, May 1967.
Philadelphia Elec Co, Pa, 10 p, 7 fig, 1 ref, append
DESCRIPTORS-- electric power/ *power system operations/ digital computers/
*electric power demand/ systems analysis/ computer programming/ economies/
*electrical networks/ electric power production/ public utilities/ electric
power industries/ operations/ benefits// transmission /electrical//
scheduling/ coordination/ planning
IDENTIFIERS-- cost savings/ generating capacity/ interconnected systems/
power grids

Typical long-range investment problems in the power industry include uncer-
tainties in forecasts concerning load growth, fuel prices, availability and
cost of capital, nuclear fuel cycle costs, investment consumption for dif-
ferent types of nuclear reactors, and possible innovations. These and many
other variables are different functions of time and are described as sto-
chastic variables. From the planner's point of view, each of the variables
is regarded as a best guess and a frequency curve for a given time period.
A new computation procedure approximating frequency curves of the variables
to a 5-step curve to shorten computer time is discussed. In the system ex-
pansion procedure, making successive decisions in time is necessary where a
decision 5 yr later is dependent on installations made 5 yr earlier or on
the outcome of independent and dependent variables in the intervening time.
Also, an earlier decision is likely to be suboptimum in light of the new
information. The proposed program represents an economic model of the
economic reality in which we live and make decisions, even if the decisions
must be based on incompetent or incomplete opinions having many variables.
                                                              R202478X67A

Ryman, Jan-Erik and Lindstroem, Goeran
GENERAL EXPANSION PLANNING--LONG RANGE INVESTMENT DECISIONS WITH DIFFERENT
ALTERNATIVES AND UNCERTAINTIES IN THE BASIC DATA (WITH SPECIAL REFERENCE TO
THE VERY LONG RANGE PLANNING OF POWER SYSTEMS). Paper, IEEE 1967 PICA
Conf Record, pp 459-477, Pittsburgh, Pa, May 1967. AB Skandinaviska
Elverk, Stockholm, Sweden, 19 p, 10 fig, 5 tab, 6 ref, append
DESCRIPTORS-- *decision making/ *planning/ *electric power production/
resources/ calculations/ *optimum development plans/ computer programming/
electric power industries/ probability/ hydroelectric power/ economics/
nuclear powerplants/ thermal power/ capital costs// interest /finance/
IDENTIFIERS-- stochastic models/ foreign research/ long-term planning/
Sweden/ investment/ fuel costs

R202479X67A PERFORMANCE OF ELECTRIC POWER SYSTEMS

A new digital computer stability program capable of representing 1000
buses, 2000 lines, and 250 machines permits analysis of large interconnect-
ed power systems. The detail in which load and machine characteristics can
be represented in the program allows calculations resulting in accurate
predictions of power system behavior under dynamic conditions. These pre-
dictions are becoming more and more important as areas of interconnected
systems increase in number and expand in size. A discussion of the philos-
ophy associated with the evolution of the program and the features and
representations incorporated therein is included.
                                                              R202479X67A

Young, C C and Webler, R M
A NEW DIGITAL COMPUTER PROGRAM FOR PREDICTING DYNAMIC PERFORMANCE OF
ELECTRIC POWER SYSTEMS. Paper, IEEE 1967 PICA Conf, pp 21-29, Pittsburgh,
Pa, May 1967. General Elec Co, Schenectady, N Y, 9 p, 11 fig, 2 ref
DESCRIPTORS-- *electric power/ *electrical stability/ *computer
programming/ characteristics/ digital computers/ systems analysis// bus
/electrical// calculations/ forecasting/ generators/ transmission lines/
machines/ circuits/ control systems/ feasibility studies/ disturbances/
excitation/ damping/ loads/ turbines/ simulation/ power system operations
IDENTIFIERS-- *interconnected systems/ *power system stability/ impedance/
*performance/ problem solving/ power grids

ELECTRIC POWER

R202480X67A OPTIMUM LOADING OF HYDROPLANT UNITS

At a hydroelectric power station containing several turbines, water required for a given power output can be minimized by the correct choice of the number of units and division of water among the different types. In a mixed hydrosteam system such as Ontario Hydro, this can result in substantial savings of fuel costs. A computer program has been written to produce tables and graphs, smoothed out for ease of operation, to show optimum water usage. Another program compares actual operation with the optimum. Use of these programs is already saving about $11,000/mo; when applied to all of Ontario Hydro's hydroelectric stations, an estimated minimum of $200,000/annum should be saved. The computer program, formulation of the basic optimum loading table, method of smoothing operation, and a performance review program are discussed. Examples of optimum loading curves and a final optimum loading table are included.

R202480X67A

**ELECTRICAL
ENGINEERING**

R202412X67A LIGHTNING AND TRANSMISSION LINES

The phenomenon of natural lightning is of interest to many people in varied diciplines; among them are meteorologists, physicists, and radio and power transmission engineers. The power transmission engineer limits his attention largely to aggregate or terminal effects and, in consonance with his knowledge of the equipment he must protect, attempts to understand and explain the lightning stroke by analogy with corona and breakdown characteristics of rod gaps and parallel conductors. The author discusses lightning components, stroke probability and density, surge impedance and potential of stroke, transmission line shielding, direct and indirect strokes, prestrike theory, difficulties of computations, and pipe-pipe gaps. Much detailed information concerning characteristics of individual strokes has been obtained, and new data are continually being accumulated. For substantially perfect shielding, protective angles of 45, 30, and 12 deg are required for ground wire heights of 50, 100, and 150 ft; for direct strokes to the ground wire, AIEE working curves and their extensions to higher voltages seem to be adequate. Has 66 references.

R202412X67A

R202415X67A CALCULATING LINE SWITCHING TRANSIENTS

Calculating transient overvoltages caused by circuit breaker operations in
loaded power systems has always been important. In the past, however,
attention was focused mainly on the restriking voltage transient occurring
when a circuit breaker opens, since this directly affects the circuit
breaker duty and design. The rise in system operating voltages and the de-
sire to keep capital costs low by reducing the system insulation level have
led to investigations of methods for calculating transient overvoltages
caused by switching long extra-high-voltage transmission lines. There are
a number of methods for calculating switching transients; however, the most
accurate may not be justified because of system-data limitations and great-
er computation costs. The paper reviews 3 methods for calculating tran-
sient overvoltages with the digital computer and describes facilities
available in a program based on the lattice-diagram method of solution of
the traveling-wave equations. The lattice-diagram method is used to exam-
ine the relative effect of various factors in the insulation coordination
of a transmission line. Has 17 references.

<div align="right">R202415X67A</div>

Bickford, J P and Doepel, P S
CALCULATION OF SWITCHING TRANSIENTS WITH PARTICULAR REFERENCE TO LINE
ENERGISATION. Proc, IEE, Engl, Vol 114, No 4, pp 465-477, Apr 1967. AEI
Pwr Systems Engg Dept, Manchester, G B; Elec Supply Comm, S Africa, 13 p,
21 fig, 2 tab, 17 ref, append
DESCRIPTORS-- *extra high voltage/ *transmission lines/ calculations/
*transients/ circuit breakers/ electric insulation/ reliability/ electric
potential/ electric currents/ electrical engineering/ resistors/ Fourier
analysis/ electric shunts/ capacitance/ electrical impedance/ digital
computers/ bibliographies
IDENTIFIERS-- *switching surges/ *overvoltage/ electrical restrikes/
electrical design/ *lattice-diagram method

R202421X67A SUPERCONDUCTING CABLE--PREDICTED DESIGNS

Superconductors offer a cable system which eventually may be more econom-
ical than conventional cable. Although cost is the main criterion, tech-
nical features affect the incorporation of superconductors into any system;
they afford low-temperature electrical insulation leading to an a-c cable
relatively free of dielectric losses and having low electrical capacitance.
Thus, long lengths can be built without a high reactive current component,
eliminating the compensating inductive reactors now needed for long runs.
Research over the past 8 yr has resulted in 3 major developments: helium is
more available; engineering techniques for low-temperature refrigerators
have improved; and alloys and compounds for superconductors carrying high-
current densities in high-magnetic fields have been discovered. Properties
of high-current superconductors are discussed, and several insulants are
considered as possibilities at low temperatures. Estimates of relative
costs and details of the first designs for 750-mva, 33-kv a-c and 750-mva,
100-kv d-c cables are given.

<div align="right">R202421X67A</div>

Norris, W T and Swift, D A
DEVELOPMENTS AUGUR DESIGN OF SUPERCONDUCTING CABLES
Elec World, Vol 168, No 4, pp 50-53, July 1967. CEGB, Leatherhead, G B,
4 p, 4 fig, 2 tab
DESCRIPTORS-- *electric cables/ research and development/ *cryogenics/
electric insulation/ capacitance/ energy losses/ electric currents/ alloys/
overloads/ refrigerators/ magnetic fields/ thermal insulation/ aluminum/
*helium/ nitrogen/ vacuum/ copper/ electrical engineering// transmission
/electrical// electric power/ electric potential
IDENTIFIERS-- *superconductors/ dielectric properties/ dielectric
absorption/ short circuits/ electrical resistance/ critical temperature

R202424X67A EARTH RESISTANCE OF DRIVEN-ROD ELECTRODES

Based on the concept that an electrode and the equipotential surfaces sur-
rounding it are similar in shape, a new method for determining earth re-
sistance of a single-rod electrode is presented. Analysis of the potential
field is then extended to evaluate earth resistance of multiple-driven-rod-
electrode systems. This analysis also substantiates that the current elec-
trode need not be kept at a great distance from the earth electrode when
experimentally determining earth resistance by the fall-of-potential meth-
od. A modification of the normal method is suggested, and a curve for ac-
curate determination of earth resistance is given. Validity of this anal-
ysis was tested by extensive field experiments and the use of an electro-
lytic tank. Close agreement between test results and computed values pro-
vides evidence supporting the basic assumption of equipotential surfaces.
R202424X67A

Datta, M; Basu, A K; Chowdhury, M M Roy
DETERMINATION OF EARTH RESISTANCE OF MULTIPLE DRIVEN-ROD ELECTRODES
DESCRIPTORS-- *electrical grounding/ electric potential/ *electrodes/
*electrical resistivity/ electric currents/ experimental data/ *electrical
engineering/ inductance/ capacitance/ resistivity surveys
IDENTIFIERS-- *earth resistivity /elect// ground currents/ electrical
resistance/ foreign research/ India

R202474 67A CORONA-CAUSED RADIO INTERFERENCE FROM EHV

A mathematical model of corona on transmission lines is coupled with an as-
sumed statistical time distribution of corona sources, leading to a method
for calculating the corona-caused electric field and evaluating radio re-
ception quality. The problem of corona-caused radio interference (RI) has
received much attention from designers of ehv transmission systems. Con-
ductor surface blemishes increase the field intensity around the conductor
and contribute to a rise in the RI level, varying directly with electric
field strength. In addition to surface condition, the environment sur-
rounding conductors significantly affects RI. Although useful analytical
data can be generated to assist in the design of ehv systems, such informa-
tion must be supplemented with experimental data obtained from actual sys-
tems operating under realistic conditions. Development of the theory and
calculation of corona-caused RI, as reported by IEEE publications over the
past 11 yr, is summarized.

R202474 67.

Smith, Richard T
THEORY AND CALCULATION OF CORONA-CAUSED RADIO INTERFERENCE FROM EHV LINES--
DESCRIPTORS-- *electrical coronas/ *radio interference/ extra high voltage/
transmission lines/ electric power/ environment/ *radio reception/ electric
fields/ mathematical analysis/ statistical analysis/ dielectrics/
capacitance/ attenuation/ electrostatics
IDENTIFIERS-- *electric conductors/ electric discharges/ electrical design

During construction of dams in the Ruhr district of West Germany, the question of permeability and grouting of solid rock as a function of the geological conditions was examined. The most reliable method for determining permeability was found to be the water pressure test with packer. Under certain geological conditions, determining the average values of permeability coefficient as a function of water absorption in the water pressure test was possible. When grouting the basement rock, adaptation of drilling direction and grout composition to textural and structural features of the rock was necessary. Conditions are explained with examples from the Henne, Sorpe, and Bremge Dams. In contrast to the opinion of Casagrande, the author proves that in an anisotropic and nonhomogeneous rock, sufficient sealing of the rock foundation is obtainable with a one-row grout curtain. For planning foundation grouting for normal geologic conditions, a set of curves showing the permissible absorption of water in relation to pressure at different water storage levels was developed from the reported investigations.

R202417 67A

Heitfeld, Karl Heinrich
THE PROBLEM OF GROUTING IN DAM CONSTRUCTION
Die Wasserwirtschaft, Vol 56, No 11, pp 366-369, 1966. Transl from German, USBR Transl 729, July 1967, 14 p, 2 fig, 2 tab, 8 ref
DESCRIPTORS-- *grouting/ *dam foundations/ *rock foundations/ water cement ratio/ permeability/ cement grouts/ grout curtains/ foreign construction/ *field permeability tests/ underseepage/ uplift pressures/ rocks/ geology/ foundation investigations/ strata/ solubility/ engineering geology/ drill holes/ slates
IDENTIFIERS-- Ruhr Region, Germany/ Germany// packers /grouting// Sorpe Dam, Germany/ Bremge Dam, Germany/ Henne Dam, Germany

R202443X67A UPLIFT CAPACITY OF SHALLOW FOUNDATIONS

Ontario Hydro's experience in designing tower foundations to resist uplift loading is discussed. Details of field and laboratory tests conducted and a comparison of the results with those reported by others are included. The general behavior of soil subjected to uplift loading is considered, and an approximate general solution for short- and long-term loading is presented. A review of previous theories and experience within Ontario Hydro had shown a lack of any generally accepted theory; therefore, simple model tests were carried out in loose and dense sands and soft and stiff clays for various anchor depth-to-width ratios. In sand, the failure mechanism was found to be influenced significantly by the surface boundary and relative density of the soil; in clays, negative pore-water pressures were observed, accounting for a large reduction in the uplift resistance under sustained loading. Simple design relationships for sand and clay were produced from the model tests; values calculated from these relationships showed reasonable agreement with results of full-scale tests on undercut augered concrete footings. More rigorous solutions are needed, however, to enable estimation of footing movements under vertical and lateral loads.
R202443X67A

Adams, J I and Hayes, D C
THE UPLIFT CAPACITY OF SHALLOW FOUNDATIONS
Ontario Hydro Res Quar, Vol 19, No 1, pp 1-13, 1st Quar 1967. 13 p, 12 fig, 3 tab, 12 ref
DESCRIPTORS-- *transmission towers/ *foundations/ foundation failures/ foundation investigations/ model tests/ *footings/ uplift pressures/ sands/ clays/ negative pore pressures/ relative density/ vertical loads/ theory/ shear strength/ coefficients/ foreign design practices
IDENTIFIERS-- belled footings/ *pull-out tests/ uplift footings/ Canada/ *uplift resistance/ auger-type footings/ failure surfaces/ Ontario Hydroelectric Comm

R202411 58A   DYNAMIC STRUCTURE OF MUDFLOWS

Artificial mudflow studies conducted in the USSR over a 4-yr period are
reported. An inexpensive method of scouring exploration trenches for geo-
logic investigations created artificial mudflows. These flows were
studied to investigate the dynamic structure of mudflows in the field.
By discharging surges of water down a hillside through a 20- by 20-cm
channel, the mudflows were produced. The first release of water washed
out some of the sediments and wet the channel bed to a depth of 40 to 60
cm. Later, successive releases of 25 to 40 cu m of water initiated the
mudflows. As the water encountered and displaced coarse detrital material,
the flow separated into several waves, each having mudflow characteristics.
The dynamics of mudflow structure are discussed, and the author concludes
that mudflows can be controlled safely by capture in pits or by barrages.
Terraces formed by the barrages are not dangerous and have possible use as
garden areas or building sites.

<div align="right">R202411 58A</div>

Ivanov, G V
NEW DATA ON THE DYNAMIC STRUCTURE OF MUDFLOWS
Bull of Moscow Soc for Natl Res, Geol Sec, Vol 33, No 1-3, pp 106-121,
1958. Transl from Russ, CFSTI Transl TT 65-50093, 16 p, 4 fig, 10 ref
DESCRIPTORS-- *mudflows/ dynamics/ detritus/ *engineering geology/ geologic
investigations/ alluvial deposits/ trenches/ control structures/ dams/
deposition/ terraces/ channeling/ scour/ waves/ sediment transport/
hydraulic excavation
IDENTIFIERS-- barriers/ foreign research/ USSR/ barrages

R202483 67A   SEISMIC PROPERTIES OF A FRIABLE MEDIUM

Knowledge acquired from numerous strong earthquakes discloses certain con-
sistent seismic characteristics for friable ground: (1) The uppermost por-
tion of the ground strongly influences the seismic effect, (2) a rigid sur-
face layer situated on more friable layers decreases the seismic effect on
structures, (3) ground water amplifies the seismic effect, and (4) seismic
effect for flooded ground is lesser than for moist ground. Classical elas-
tic wave theory does not explain these phenomena satisfactorily. The con-
cept of friability is reviewed and an elastic model of a friable medium
proposed. Some simple cases of elastic wave propagation in a friable medi-
um are considered, and experimental methods for friable ground studies
leading to a better understanding of wave propagation and microseismic
zoning are outlined.

<div align="right">R202483 67A</div>

Nikolaev, A V
THE SEISMIC PROPERTIES OF A FRIABLE MEDIUM
Physics of Solid Earth, Vol 3, No 2, pp 85-90, Feb 1967. Izv, Acad of Sci,
USSR, 6 p, 4 fig, 8 ref
DESCRIPTORS-- *geophysics/ *seismic investigations/ *seismic properties/
seismic waves/ seismology/ *earthquakes/ wave velocity/ elasticity/ ground
water/ granular materials/ longitudinal waves/ soil moisture/ transverse
waves/ boreholes/ vibrations/ *noncohesive soils
IDENTIFIERS-- elastic waves/ *wave propagation/ foreign research/ USSR/
mathematical models

Plane turbulent wall jets, similar to those occurring under high-head
sluice gates, were studied under zero pressure gradient on rough bounda-
ries. Six types of rough boundaries with relative roughness factors vary-
ing from 0.00455 to 0.126 were investigated. For the major part of the
boundary layer, velocity distribution is correlated by the velocity defect
law. In a power law-type equation for the velocity distribution, the expo-
nent is found to vary from 1/2 to 1/8 for the range studied. Boundary
layer growth is correlated roughly by the Bauer method for studying bound-
ary layer development of spillways. In the fully developed zone, velocity
distribution in the entire wall jet cannot be described by a single-length
scale; the wall jet must be divided into a boundary layer and free-mixing
region. The modified velocity distribution curve of the classical wall jet
successfully describes velocity distribution in the free-mixing portion of
wall jets with rough boundaries. The length scale is found to be unaffect-
ed by rough boundaries which considerably affect decay of the maximum ve-
locity. Using the distance from the efflux section for a given relative
roughness, a method for predicting decay of the maximum velocity was devel-
oped. Flow entrainment, momentum fall, and energy fall in the flow below a
high-head sluice gate with a rough bed were studied also. Has 30 ref.
                                                         R202419X67A

R202428 67A FRIANT-KERN CANAL FLOW MEASUREMENT

Radioisotope discharge measurements were performed on 2 sections of the
Friant-Kern Canal during the period August 10-14, 1964, to determine water
losses in the canal. A concrete-lined section between Friant Dam and Mile
29 and an earth-lined section between Mile 35 and Mile 53 served as the
test reaches. Eight radioisotope injections were made, resulting in 24
individual discharge rate determinations. The discharge values obtained
with the radioisotope measurements ranged from 2643 to 3128 cfs and were
compared to the results of current meter measurements and the discharges
indicated by calibrated hollow-jet valves at Friant Dam. Measurement accu-
racies based on the above comparison were all within 9.5%, but many were
within 2%. The integrated sample and total count methods were used to de-
termine the discharge with radioisotopes. A waterproof scintillation
counter and 2 Geiger counters were used in the tests. New methods of field
calibration of the immersed counter were tested successfully to calibrate
the scintillation counter.
                                                         R202428 67A

R202441X67A CORRELATION OF UNIFORM PIPE FLOW DATA

The theory of correlation of uniform flow resistance data for pipes, based on the concept of dynamic velocities, is discussed. A definitive study of arrangements of diagrams gives direct solutions of flow problems. After review of past work, some new forms of diagrams are given; one is based on the familiar Stanton diagram, providing direct dimensionless solutions for all forms of the problem. Amplification of the Stanton diagram permitting dimensional working is illustrated. Assigning equivalent sand roughness sizes to particular surfaces without the Nikuradse test range of relative roughness, or extrapolating from the Nikuradse test range to larger values of relative roughness using a logarithmic formula, is not presently justifiable; thus, generation of data for resistance charts by the Colebrook-White formula is suspect. Diagrams depending largely on the equivalent sand roughness sizes as a linear measure, such as Powell's and Acker's diagrams, and 2 of the author's new diagrams, eventually may require modification. On the author's Stanton diagram-based arrangement, the physical significance of the interrelation of the variables is highlighted, and modification of the single diagram for dimensionless and dimensional application will not present great difficulty. Has 21 references.

R202441X67A

R202451 67A SCOURING CAPACITY OF AIR-WATER JETS

Passage of a jet through air can cause air entrainment leading to differences in scouring capacity of the jet. During spillway model studies, differing indications of scour depth, in the ratio of 2:1, have been attributed to this effect. To examine the magnitude of air entrainment effects, a series of tests were undertaken on a specially designed installation. The apparatus comprised an 8-cu m tank, 1 m deep, containing gravel; a vertical jet nozzle set above it; and water and air supply and measuring systems. The semicircular jet nozzle was mounted with its flat side flush with the inner face of a transparent wall of the tank. Flow, air content, tailwater depth, and flow duration were varied and the effects noted on rate and depth of scour. A typical comparison of scour depth-tailwater depth relationships is shown for the plain jet, split jet, and aerated jet. Variation in jet penetration with tailwater at different jet discharges is shown for a plain water jet and an air-water jet. Formulas for predicting scour at the base of a free overfall are compared graphically with the test results; the observed correlation is discussed. The time function of scour is considered and a dynamic scour depth limit is differentiated from the more common static limit.

R202451 67A

Some of the parameters affecting radial diffusion are discussed. The anal-
ogy between the radial diffusion coefficient and the eddy viscosity is used
to obtain an equation for calculating the diffusion coefficient K. Analyt-
ical concentration distributions are presented for steady-state diffusion
from a source on the centerline of the pipe. The analytical distributions
are used to calculate empirical K-values. Forty K-values from various
sources are presented. These data show that: (1) the amount of lateral
spread of the diffusing substance in the pipe has a significant effect on
the value of K, and (2) the analogy of diffusion with the eddy viscosity is
a fair approximation for K when the diffusing substance fills the pipe
cross section. An equation is derived for estimating the distance required
for complete mixing in uniform pipe flow. Has 16 references.

<div align="right">R202455 67A</div>

Holley, Edward R and Schuster, Jack C
RADIAL DIFFUSION IN TURBULENT PIPE FLOW
Proc, 12th Cong of IAHR, Vol 4, pp 124-136, Fort Collins, Colo, Sept 1967.
U of Illinois, Urbana; Bureau of Reclamation, Denver, Colo, 13 p, 4 fig,
1 tab, 16 ref
DESCRIPTORS-- *closed conduit flow/ *pipes/ bibliographies/ *turbulence/
tracers/ radioactive isotopes/ *turbulent flow/ hydraulics/ closed
conduits/ pipelines/ mixing/ eddies/ *diffusion/ flow diagrams
IDENTIFIERS-- *radial diffusion/ diffusion coefficient

R202456 67A HYDRAULIC RADIUS AND OPEN CHANNEL FLOW

The validity of applying the hydraulic radius as a sole geometric quantity
for various channel shapes in computing turbulent uniform flow is dis-
cussed. Flows in smooth rectangular channels of 0.24 and 0.75 ft in width
were analyzed for aspect ratios ranging from about 0.5 to 10. Data col-
lected from the two channels for mild and steep slopes are presented in
graphical form and mostly as dimensionless parameters; i.e., friction fac-
tor, Reynolds number, modified Reynolds number, and aspect ratio of rectan-
gular channels. Results show that for a given hydraulic radius, channel
slope, and roughness, the increase in mean velocity of turbulent uniform
flow or the decrease in flow resistance is attributed to the lowering as-
pect ratio. This trend toward less flow resistance appears to be more evi-
dent for the mild slope than the steep slope. Conclusions were: (1) appli-
cation of the hydraulic radius in uniform flow analysis is valid if the as-
pect ratio is greater than about 2; (2) use of the hydraulic radius should
be coupled with consideration of the effect of channel shape if the aspect
ratio is less than about 2; and (3) relationship between the friction fac-
tor and the modified Reynolds number is more suitable for use with the
Darcy-Weisbach uniform flow formula.

<div align="right">R202456 67A</div>

Shih, Cornelius C and Grigg, Neil S
A RECONSIDERATION OF THE HYDRAULIC RADIUS AS A GEOMETRIC QUANTITY IN OPEN
CHANNEL HYDRAULICS. Proc, 12th Cong of IAHR, Vol 1, pp 288-296, Fort
Collins, Colo, Sept 1967. U of Alabama, Huntsville; Colorado State U, Fort
Collins, 9 p, 7 fig, 12 ref
DESCRIPTORS-- *open channel flow/ open channels/ *hydraulic radius/ slopes/
turbulent flow/ *rectangular conduits/ shapes/ roughness/ roughness
coefficients/ Reynolds number/ hydraulics/ laboratory tests/ hydraulic
models
IDENTIFIERS-- aspect ratio// friction coefficient /hyd// Darcy-Weisbach
formula

HYDRAULICS

R202457 67A FLOOD CONTROL CHANNEL HYDRAULICS

Concrete-lined open channels have been used frequently to control floods on steep gradient streams in highly developed industrial and urban areas of the U S. Gradients of the streams ranged from 25 to 200 ft per mi and produced eroding velocities in the natural channels. Methods are described for resolving some of the problems encountered when: (1) high-velocity flow traverses short radius curves in both rectangular and trapezoidal channels and (2) two high-velocity tributary flows join at a confluence. Illustrations of prototype and model installations are given for designs used in the construction of flood control channels by the Corps of Engineers in Southern Calif.

R202457 67A

Gildea, Albert P and Wong, Ralph F
FLOOD CONTROL CHANNEL HYDRAULICS
Proc, 12th Cong of IAHR, Vol 1, pp 330-337, Fort Collins, Colo, Sept 1967.
U S Army Corps of Engrs, Los Angeles, Calif, 8 p, 12 fig, 1 tab
DESCRIPTORS-- *flood control/ *channels/ *open channels/ *open channel flow/ rectangular conduits/ trapezoidal channels/ supercritical flow/ urban areas/ turbulent flow/ curves/ hydraulic models/ inlets/ sediment control/ design criteria/ *channel improvements/ hydraulics
IDENTIFIERS-- high velocity/ superelevation/ confluence/ California

R202471 67A ACOUSTIC VELOCITY METER

The acoustic velocity meter measures the flow of water through pipes, stream channels, or other conveyances by means of sound waves. Water velocity is determined by measuring the transit time of an acoustic signal through flowing water. The velocity of the signal is the algebraic sum of the velocity of sound in still water and the component of water velocity as measured along the acoustic path; average velocity and total flow are easily obtained mathematically. The device does not interfere in any way with the flow of water and is a logical instrument for water measurement where head is not proportional to flow, as in weir-controlled canals, tidal estuaries, pipes, submerged stream gaging stations, and pumped storage interconnections. This system is the main hope for measuring net outflow from the Sacramento-San Joaquin Delta. Acoustic velocity meter systems developed by Westinghouse, Lockheed, and USGS are reviewed.

R202471 67A

Huffman, Elmo W
THE ACOUSTIC VELOCITY METER
Tech Memo 24, California Dept of Water Resrcs, Sacramento, July 1967.
30 p, 5 fig, 5 ref
DESCRIPTORS-- *flow meters/ fluid flow/ velocity/ *velocity meters/ *water meters/ acoustic equipment/ sonic waves/ *water measurement/ measuring instruments/ instrumentation/ transducers/ ultrasonics/ underwater sound/ electronics/ electronic equipment/ hydraulics
IDENTIFIERS-- flow measurement/ ultrasonic flow measurement/ acoustic velocity meters

22

The phenomenon of cavitation in a horizontal pipeline, emphasizing the in-
fluences of compressibility of water and force of gravity on the formation
and spreading of a cavity, is described. This cavitation is considered a
particular case of water hammer. If pressure somewhere in a pipeline is
reduced to a value which would induce cavitation, a cavity will form at the
reduced pressure location. If the cavity then collapses, the collapse may
be accompanied by extremely high pressures. In practice, such phenomena
may occur in pipelines when supply pumps suddenly stop. From the general
equation of continuity and both equations of motion, a system of equations
is derived having the same form inside and outside the cavitation region.
A numerical method for a step-by-step solution of the equations is
presented.

R202430X67A BANK STABILIZATION USING STEEL JACKS   HYDROLOGY

Several test sections were constructed to determine the best method of con-
trolling bank erosion along the Frenchman River in Nebraska. After 3 yr of
observing these test sections, the following conclusions were drawn: (1)
Steel jacks are more effective in arresting bank erosion than piling and
fencing. Jacks were installed for about $3.40 per lin ft, whereas piling
and fence are much more costly. (2) Minimum radius for jack alinement
should be about 50 ft. (3) The rate at which a line of jacks can develop
efficient sediment deposit to form a new stabilized bank line depends pri-
marily on the trapped debris, sediment carried by the stream, and reduction
in stream velocity behind the jacks. (4) The best position for individual
jacks is such that one axis of the jack is on a plane 10 to 50 deg down-
stream from a line normal to streamflow. (5) Bank stabilization can be ex-
pedited by sloping the bank behind the jacks, allowing vegetation to get an
early start; also, sediment deposit can be accelerated by placing trees and
brush between the jacks and bank. (6) Use of retard lines should be limit-
ed to locations where a wide area of sediment deposit is desired. (7) Gen-
erally, jacks should be placed close to the existing bank in areas of clear
water. (8) Placing double rows of parallel jacks is normally of little
advantage.

R202438X67A TURBIDITY IN TRINITY RIVER AFTER STORMS

A study was made to determine the magnitude and duration of turbidity fol-
lowing heavy storms on the Trinity River Division of the USBR's Central
Valley Project. The degree of treatment necessary to provide satisfactory
domestic water from the impounded river water was investigated also. Find-
ings were: (1) Storms with precipitation of 2¨ to 4 in. per day caused tur-
bidity increases up to 35 ppm at some of the impoundment sampling stations.
Turbidity decreased to less than 5 ppm within several weeks after the
storm. (2) The December 1964 storm with precipitation of 5 to more than
10 in. per day caused marked turbidity increases as great as several hun-
dred ppm in the Trinity Division waters. Storm-caused turbidity persisted
from 5 to 11 mo at the sampling stations before dropping to the 5 ppm
level. (3) Turbid water inflows to the 250,000-acre-ft Whiskeytown Reser-
voir reached the reservoir outlets within 4 to 5 days. Some sedimentation
had occurred in the impoundment in the reservoir since the outflow turbid-
ities were less than the inflow turbidities. (4) Provision of multiple
outlets in the dams to permit withdrawal of water from more than one eleva-
tion will provide clearer water for domestic and recreational use down-
stream.

R202438X67A

Heinzel, Lloyd R
STORM EFFECTS ON TURBIDITY IN TRINITY PROJECT WATERS
Jour AWWA, Vol 59, No 7, pp 835-842, July 1967. California State Dept of
Public Health, Redding, 8 p, 5 fig, 2 tab, 4 ref
DESCRIPTORS-- *turbidity/ *storms/ reservoirs/ *water quality/ hydraulics/
rainfall/ water sampling/ water analysis/ stratification/ density currents/
turbidimeters/ *suspended sediments/ clay minerals/ sediments/ silts/ water
treatment/ flood
IDENTIFIERS-- *Trinity River Division, CVP/ multilevel outlets/ selective
level releases/ Whiskeytown Dam, Calif/ thermal stratification/ Trinity
Dam, Calif

R202482 67A AUTOMATION OF SURFACE IRRIGATION

Recently improved surface irrigation methods and equipment using mechanized
automated control structures enable farmers to apply water with minimum
labor and obtain maximum benefits. A review is given of the recent devel-
opments in automatic irrigation, including a canvas dam released by an
alarm-clock timer; self-propelled traveling siphon; radio-controlled system
for border irrigation using a moisture sensing device; pneumatically opera-
ted radio-controlled valve to vary discharge from turnout structures; and
an automatic furrow cutback flow irrigation system reducing flow as furrows
are reached by advancing water. The automatic irrigation program at the
Snake River Conservation Research Center at Kimberly, Idaho, is described.

R202482 67A

Humpherys, Allan S
RECENT DEVELOPMENTS IN THE AUTOMATION OF SURFACE IRRIGATION
Rept H-007, ASAE, St Joseph, Mich, 1967. ARS, USDA, Kimberly, Idaho, 18 p,
6 fig, 17 ref
DESCRIPTORS-- *surface irrigation/ *automation/ *automatic/ bibliographies/
*automatic control/ water management/ irrigation/ irrigation systems/ check
structures/ efficiencies/ instrumentation/ sprinkler irrigation/ irrigation
efficiencies/ gates/ flap valves/ water measurement/ remote control
systems/ labor/ costs// drops /structures// valves/ check dams/ portable
IDENTIFIERS-- water use/ recirculating irrig system/ border irrigation//
canvas dam /irrigation// O-ring seals/ furrow irrigation/ Snake River Cons
Res Ctr

R202434X67A ANNUAL REVIEW OF ADHESIVES

New adhesives are being synthesized and formulated continually to meet the
ever increasing demand for materials capable of withstanding extreme envi-
ronmental conditions. In most cases, the adhesive is a synthetic high
polymer. The ability of a resin to perform satisfactorily depends upon the
fundamentals of polymer science, such as hydrogen bonding, cohesive energy
density, flexibility, molecular organization, crystallization, cross link-
ing, and wetting. High-temperature adhesives, neoprene cements, hot-melt
adhesives, development of a 1-package structural adhesive, and substrate
treatments to improve bonding are reviewed. Lists 33 references.
<div align="right">R202434X67A</div>

R202435X67A ANNUAL REVIEW OF PROTECTIVE COATINGS

Developments in polymer coatings are reviewed to spot trends and provide
background information for those in the coatings profession and workers in
related fields desiring an instant updating in this technology. The pre-
sent advances in coatings technology are characterized by: (1) additions
to the existing families of polymers by synthesis and evolutionary modi-
fications and (2) the formulation of coatings by application of physics and
physical chemistry techniques. Developments in synthetic resins are re-
ported for polyesters, water-based coating resins, thermosetting acrylics,
fusion coatings, high-build coatings, silicate coatings, new polymers, and
electron curing. Traditional coating formulation practices based on random
selection of raw materials, followed by testing in use, are becoming more
sophisticated through the use of computers for calculating various resin
permutations. This review also includes progress in pigment and dispersion
investigations, corrosion protection, performance and weathering tests, and
analytical techniques. Has 172 references.
<div align="right">R202435X67A</div>

R202436X67A ANNUAL REVIEW OF ELASTOMERS

A general review of the literature appearing in the most widely distributed
rubber journals is presented. The review covers developments in produc-
tion, processing, and commercial applications of rubber; rubber tire tech-
nology is stressed, but other applications are mentioned. Applications of
computer techniques in compounding new elastomeric materials are discussed
briefly. Compounding materials examined include polyisoprenes, polybutadi-
ene, ethylene propylene, polyurethanes, several other elastomers, and poly-
mer blends. Rubber processing, vulcanizing, aging, and physical testing
are reviewed. The development of elastomeric compounds for such products
as rubber tires, rocket components, threads, and padding for applications
under diverse environmental conditions continues to depend upon the devel-
opment of laboratory tests to cover the appropriate conditions. Has 85
references.

R202436X67A

Alliger, Glen and Weissert, Fred C
ELASTOMERS
Ind & Engg Chem, Vol 59, No 8, pp 80-90, Aug 1967. Firestone Tire & Rubber
Co, Akron, Ohio, 11 p, 1 photo, 85 ref
DESCRIPTORS-- *elastomers/ reviews/ bibliographies/ *rubber/ laboratory
tests/ test procedures/ production/ tires/ chemical engineering/ organic
compounds/ *materials/ materials forming/ computers/ composite materials/
foams/ foam rubber/ molecular structure/ aging/ mechanical properties/
deformation/ elasticity/ environmental tests/ *polymers/ wear resistance
IDENTIFIERS-- vulcanization/ polyurethane resins/ isoprene/ butyl rubber

R202437X67A ANNUAL REVIEW OF PLASTICS TECHNOLOGY

A review of developments in plastics technology, briefly commenting on the
impact of plastic products on modern civilization, is presented. Plastic
products discussed include containers, composite materials, plastic films,
protective coatings, plastic pipe, and foams. Resistance of plastics to
weathering, temperature, and fire is examined. Plastics reviewed include
phenolic compounds, epoxies, polyolefins, vinyls, styrenes, polyamides,
acrylates, and polyurethanes. Analytical procedures are mentioned briefly.
Lists 429 references.

R202437X67A

Seymour, Raymond B
PLASTICS TECHNOLOGY
Ind & Engg Chem, Vol 59, No 8, pp 62-74, Aug 1967. U of Houston, Tex,
13 p, 3 photo, 429 ref
DESCRIPTORS-- *plastics/ plastic tubing/ containers/ foams/ sheets/ films/
reviews/ protective coatings/ *materials/ building materials/ weathering/
aging/ temperature/ *polymers/ bibliographies/ phenolic plastics/ epoxies/
thermoplastics/ vinyl plastics/ styrenes
IDENTIFIERS-- acrylic resins/ polyamides/ polyurethane resins/
thermosetting plastics

R202470X67A STRESS-CORROSION AND ELECTRICAL FAILURES

Stress-corrosion cracking and its significance in the field of electrical
engineering are discussed. This cracking is a phenomenon resulting in the
brittle failure of normally ductile alloys when exposed to the combined ac-
tion of tensile stress and corrosion. The rate of cracking is low by brit-
tle fracture standards but very high for penetration by corrosion alone.
Certain alloys are especially prone to this type of failure, and chemical
conditions are specific for each case. Failure can be caused by residual
and applied low-tensile stress producing no permanent change in the metal
in the absence of corrosion and by mild environments producing little cor-
rosion in the absence of stress. A spectrum of mechanisms is apparent in
which the relative roles of stress and corrosion are gradually reversed as
the spectrum is traversed. This wide range of failure mechanisms indicates
that behavior of susceptible alloys must be evaluated in each particular
environment and stress field. Specific examples of stress-corrosion
cracking and its effect on electrical equipment are given.

R202470X67A

R202442X67A AN INTRODUCTION TO DECISION TABLES

Decision tables were developed and organized to analyze, program, and doc-
ument (1) tabular representations of relationships between variables and
parameters and (2) sets of conditions and related sequences of actions
which make up sets of rules. A description of different table formats,
an explanation of basic fundamentals, and related terminology of decision
tables are reviewed. Instructions for preparing decision tables, sugges-
tions for organizing the data within the table for analysis, and rules for
interpreting the meaning of the data relationships are discussed. Several
examples of decision tables are included to assist the reader in developing
tables for other applications. The use of decision tables for analyzing
data and structuring their relationships simplifies the computer program-
ming task and reduces the storage requirements for processing. A usage
guide for determining types of data-handling tasks which can be analyzed
most efficiently with decision tables is presented. The author summarizes
the advantages of using decision tables for analyzing, programming, and
documenting computer-based systems. Has 27 references.

R202442X67A

R202413 67A PERIODIC SURGES IN FRANCIS TURBINES

The new high-head Francis turbines designed for use at Bratsk and
Krasnoiarsk Powerplants necessitated a thorough investigation of the dynam-
ic flow processes in such turbines. These studies were conducted in labo-
ratories and operating powerplants by Soviet research organizations. Test
equipment and procedures are described and results given on the study of
low-frequency periodic pressure surges in spiral cases and draft tubes.
Two basic types of periodic surges can be distinguished--rotational and
vortical. The first type has a frequency near that of rotation, appears in
the spiral case but not in the draft tube, and causes so much vibration of
the turbine head cover and support bracket that the unit cannot be operat-
ed. This surge is associated with water filling the gap between the head
cover and the runner after a break in flow and being discharged at differ-
ent rates by relief valves to the draft tube. Significant resonance occurs
at a specific relative penstock length, for which a formula is given. Vor-
tical surges, starting in the draft tube, and at partial loads often trans-
mitted by the pier to the spiral case and penstock, cause a circulation in
the discharge leading to negative pressures at the diffuser and overpres-
sures at the periphery. At partial loads there is a significant sinusoidal
pulsation.

R202413 67A

R202462 67A STRESS ANALYSIS OF HYDRAULIC MACHINERY

The finite element technique of stress analysis is a method whereby complex
2-dimensional or axisymmetric structures are mathematically represented by
a finite number of separate elements interconnected at a finite number of
nodal points. Stress analysis of complex hydraulic machinery by advanced
computerized analytical methods is described. The theory of the finite
element method and computer programs used in the analysis are discussed.
This method of stress analysis is illustrated by analyzing stresses in pump
turbine head covers of the Oroville Powerplant and stresses in the turbine
stay ring of the Thermalito Powerplant. Present experience with the finite
element technique indicates that it provides a highly accurate representa-
tion of the stresses and deflections and gives the engineer a superior in-
sight into the structural behavior of complex hydraulic machinery.

R202462 67A

Information on the crystallization of supercooled water is needed for
solving a number of problems related to winter operation of power stations.
Studies conducted at Moscow State University on formation and growth of
frazil ice crystals in moving flow are reported. Experimental results are
presented on size distribution functions of frazil ice crystals formed and
grown in turbulent flow. An analytical expression for size distribution is
obtained from the experimental data. The coefficient determining the loca-
tion of the maximum point on the crystal size distribution curve depends on
the time that passes after the moment of maximum supercooling of the water:
the shorter the time, the larger the coefficient. The shape of the crystal
size distribution curve indicates that crystal origination is of a cascad-
ing nature during the initial nucleation and growth period when there is
adequate supercooling.

<div align="right">R202466 67A</div>

Although friction in rocks is theoretically important in the Coulomb cri-
terion of rock fracture, modified Griffith theory of fracture, attenuation
of seismic waves, and determination of Young's modulus and Poisson's ra-
tio, the physical processes involved in the frictional sliding of brittle
rocks are not clear. Physical processes in frictional sliding and effects
of surface roughness and confining pressure on the coefficient of friction
are reported. Changes in friction with displacement, load dependence of
friction, and effects of water are discussed. At high confining pressures,
friction between ground surfaces of granite reaches a maximum value after
0.1 cm displacement and then decreases to a nearly constant value after
sliding 0.5 cm. This maximum value is nearly the same as the initial value
for perfectly mated rough surfaces. Decrease in friction is probably
caused by rolling on wear particles. Under increasing confining pressures,
friction decreases with increases in normal stress. Sliding movements oc-
cur with violent stick-slip and appear to be controlled by brittle frac-
ture. Test results on granite are not in agreement with the Coulomb theory
of rock fracture but are consistent with the effective stress theory as
applied to friction. Has 32 references.

<div align="right">R202409 67A</div>

R202414 67A VIBRATING WIRE INSTRUMENTS

Vibrating wire methods are new and relatively untried in Canada and the U S
but have been developed to a high degree, especially by the British Build-
ing Research Station. Vibrating wire gages are basically mechanical in-
struments; therefore, they have an advantage over strictly electrical
strain gages in that any changes in the properties of the electrical cir-
cuit do not alter the gage or its frequency. These instruments are partic-
ularly useful in fieldwork where electrical circuits are prone to damage
and deterioration. Basic operating principles are given, and literature
concerning the development of the instruments is covered briefly but com-
prehensively. Twenty Maihak vibrating wire piezometers and 10 Maihak vi-
brating wire earth pressure cells were installed in Wildwood Dam, a rolled
earthfill dam in Ontario, Can. Laboratory and field tests, installation,
and evaluation of the instruments and conductor cables are described. The
instruments appear quite stable and suitable for their purpose; however,
the piezometers encounter the same difficulties as any other type of pie-
zometer in partially saturated soil when the pore water pressure approaches
absolute zero. Has 66 references.

R202414 67A

Scott, J D and Kilgour, J
EXPERIENCE WITH SOME VIBRATING WIRE INSTRUMENTS
Can Geotech Jour, Vol 4, No 1, pp 100-123, Feb 1967. U of Ottawa, Canada;
Assoc Geotech Serv Ltd, Toronto, Canada, 24 p, 10 fig, 1 tab, 66 ref, disc
DESCRIPTORS-- bibliographies/ vibrations/ gages/ *piezometers/ field
investigations/ earth dams/ *earth pressures/ measuring instruments/ pore
pressures/ frequency/ *strain gages/ pressure gages/ pressure sensors/ pore
air pressures/ soil tests/ foreign design practices/ pore water pressures/
soil mechanics/ instrumentation
IDENTIFIERS-- *pressure cells/ in situ tests/ *vibrating-wire strain gage/
Wildwood Dam, Canada/ Canada/ foreign products/ product evaluation

R202418X67A LIME-SOIL MIXTURE ENGINEERING PROPERTIES

When lime-reactive soils are stabilized with quality lime, the cured lime-
soil mixtures display substantial compressive, shear, and tensile strengths
and the stress-strain properties are altered (higher modulus of elasticity,
lower failure strains) in comparison to the natural soil. Many of these
materials can be used successfully as bases or subbases for typical highway
pavements, assuming that durability is adequate. Results of the studies
reported in this paper indicate the general range of strength (compressive,
shear, tensile, CBR) for typical Midwestern U S soils stabilized with lime;
data pertaining to flexural fatigue and stress-strain properties also are
presented. Since properties of a lime-soil mixture change with further
curing (due to the development of additional cementing products), conduct-
ing elaborate field tests to precisely evaluate properties that will change
due to field curing effects may not be justified. Use of unconfined com-
pressive strength for evaluating quality of the mixture and estimation of
other pertinent mixture properties using correlations similar to those de-
veloped in this study are suggested. Has 15 references.

R202418X67A

Thompson, M R
ENGINEERING PROPERTIES OF LIME-SOIL MIXTURES
Preprint, ASTM Paper 78, 70th Ann Mtg, Boston, Mass, June 1967. U of
Illinois, Urbana, 31 p, 10 fig, 3 tab, 15 ref
DESCRIPTORS-- *lime soil mixtures/ *soil physical properties/ pavements/
subbase/ subgrade/ *soil investigations/ elasticity modulus/ lime/ *soil
stabilization/ stress-strain curves/ Poisson ratio/ shear strength/
compressive strength/ splitting tensile strength/ unconfined compression/
finegrained soils/ test procedures/ California bearing ratio// fatigue
/mechanics// soil mechanics/ bibliographies/ highways
IDENTIFIERS-- Illinois

R202422 67A FIELD VANE SHEAR TESTS AT WILLARD DAM

Willard Dam comprises an embankment of over 16 million cu yd constructed
on a very soft foundation of 130 ft of predominately lacustrine soils.
The embankment was raised in 3 stages to 35 ft above original ground sur-
face, permitting strength increase in the foundation between each stage.
Strength increase was measured by means of the Bureau of Reclamation field
vane test. These tests indicated that the measured strength increased con-
currently with consolidation and drainage of the subsurface strata and that
the variation of the maximum vane shear strength, vertically and horizon-
tally beneath the embankment, coincided with a computed embankment vertical
stress distribution. Strength increases as much as twice the initial val-
ues were measured beneath the center of the embankment. Preconstruction
investigations and studies during construction are discussed, foundation
conditions are described, and field vane test procedures and results are
presented.

R202422 67A

Esmiol, Elbert E
THE FIELD VANE TEST--A CONSTRUCTION CONTROL DEVICE
Paper, 3rd Pan-Amer Conf on Soil Mech & Fdn Engg, Caracas, Venezuela, July
1967. Bureau of Reclamation, Denver, Colo, 28 p, 12 fig, 8 ref
DESCRIPTORS-- clays/ cohesion/ consolidation/ *dam design/ plasticity
index/ soil mechanics/ neutral stress/ pore pressures/ shear strength/
stability analysis/ embankments/ lacustrine deposits/ relative consistency/
*earth dams/ *dam foundations/ foundation investigations/ moisture content/
organic soils/ safety factors/ *vane shear tests/ field control
IDENTIFIERS-- Willard Dam, Utah/ Utah/ stage construction/ construction
control

R202423 66A SEEPAGE FROM CLAY-LINED PONDS

A simple method for analyzing seepage from clay-lined ponds is presented.
The analysis is based upon steady-state seepage occurring after equilibrium
is attained between the pond's water level and the water table. With equal
flow rates through the lining and subsoil, Darcy's law is applied to ana-
lyze the effects of pond depth and permeability and thickness of the lining
and subsoil. Seepage is also affected by the depth of the water table and
the pore water pressure profile. For unlined ponds, the pore pressure is
positive down to the water table; for relatively impervious linings, the
pore pressure changes from positive to negative. With access to air, nega-
tive pore pressures cause desaturation of pervious material with a conse-
quent decrease in permeability. The study concludes that if aeration of
the subsoil is possible, a low water table is advantageous; if aeration is
not possible, seepage may be reduced by raising the water table. To effec-
tively control seepage, the lining permeability should be less than 1% of
the subsoil permeability. A thin layer of highly impervious material is
more effective than a greater thickness of more pervious material.

R202423 66A

Blight, G E
SEEPAGE FROM CLAY-LINED PONDS
The Civil Engr in S Africa, Vol 8, No 7, pp 215-221, July 1966. CSIR,
Pretoria, S Africa, 7 p, 11 fig, 7 ref
DESCRIPTORS-- *ponds/ *seepage/ *seepage losses/ reservoirs/ clays/
*earth linings/ sands/ pore water pressures/ negative pore pressures/
pervious soils/ impervious linings/ foreign design practices/ permeability/
ground water/ water table/ subsoil/ pore pressures/ saturation/ *lower
cost canal linings
IDENTIFIERS-- Darcys law/ South Africa

R202458X67A ELECTROKINETICS APPLICATIONS IN GROUTING

Electrokinetic phenomena are associated with the application of an electri-
cal field to soil; usually direct current is utilized. The electric field
causes water to flow through the pores of soils of low permeability and,
for a variety of reasons, hardens the soil. While the electric field is
being applied, permeability of the soil is increased by a factor of 2 or
more, thereby reducing the time required to introduce a grout when pumping
at a specified pressure. The electric field also acts to pump grout into
the soil or causes the development of negative pore pressures near a grout
pipe, thus effectively increasing the grouting pressures without increasing
the danger of surface heave. A summary is presented of some recently re-
ported successful applications of electrokinetics in grouting in Rumania,
Israel, the United States, and Great Britain. Several possible limitations
of the method are suggested and an indication of the cost of power is
presented. Has 21 references.

<div align="right">R202458X67A</div>

Esrig, Melvin I
APPLICATIONS OF ELECTROKINETICS IN GROUTING
Conf Preprint 480, ASCE Struc Engg Conf, Seattle, Wash, May 1967. Cornell
U, Ithaca, N Y, 31 p, 7 fig, 21 ref
DESCRIPTORS-- *electrokinetics/ *grouting/ bibliographies/ soils/ direct
currents/ permeability/ electric fields/ negative pore pressures/ heaving/
hydraulic gradients/ flow/ sodium chlorides/ *soil stabilization/ costs/
chemicals/ bentonites/ soil mechanics/ chemical grouts/ electrodes
IDENTIFIERS-- sodium silicate

R202463 67A SOIL COMPACTION FIELD STUDY

Full-scale field tests dealing with soil compaction for highway construc-
tion were undertaken to determine: (1) desired characteristics of compacted
soil, (2) how best to measure and specify proper compaction, and (3) effec-
tiveness of various methods of achieving compaction. Test variables in-
cluded: type of soil or base course material, moisture content, lift thick-
ness, type of compaction equipment, compactive effort, and number of roller
coverages. Measurements of soil properties were made using a cone pene-
trometer, 6-in. bearing plate, California bearing ratio apparatus, seismo-
graph, portable nuclear moisture-density instrument, nuclear road logger
and sand cone, together with conventional moisture content procedures.
Experiments were divided into 6 sets, 3 for subgrade soils and 3 for base
course materials, each incorporating some of the independent variables for
different purposes. Statistical techniques were used for planning experi-
ments and analyzing data. Scope of field tests, plans, procedures, and
type of information being obtained are described.

<div align="right">R202463 67A</div>

Hampton, Delon and Selig, E T
FIELD STUDY OF SOIL COMPACTION
Hwy Res Record, No 177, pp 44-57, 1967. Illinois Inst of Technol, Chicago,
14 p, 7 fig, 6 tab, 5 ref
DESCRIPTORS-- *compaction/ *soil compaction/ highways/ *compaction tests/
soils/ *field tests/ *compaction equipment/ moisture content/ base courses/
subgrade/ rollers// vibrators /mechanical// prototype tests/ penetrometers/
test procedures/ density/ soil physical properties/ soil mechanics/
California bearing ratio
IDENTIFIERS-- nuclear density meters

Properties of field compacted soils and factors influencing soil compaction
were investigated by a series of soil compaction tests. Test sections of
soil in single lifts were compacted on a prepared foundation using a varie-
ty of commercial rollers. The main parameters varied were soil type, mois-
ture content, lift thickness, compaction equipment, and compactive effort.
The test plan was based upon a statistical model, permitting separation of
real effects from random variability. Soil strength, stiffness, and densi-
ty measurements were made using a variety of techniques. The effects of
the selected variables on the measured soil properties were detected by
conducting a full factorial experiment consisting of 256 test sections and
by using analysis of variance techniques. Effect of the test variables on
CBR, penetration resistance, bearing stiffness, seismic velocity, and den-
sity are discussed, and field and standard laboratory measurements of den-
sity and CBR are compared.

R202464 67A

R202465 67A   EMBANKMENT COMPACTION STATISTICAL STUDY

The distribution of percent relative compaction obtained with current soil
compaction control procedures was analyzed statistically. The survey in-
cluded 3 embankment projects whose soils varied from homogeneous to very
heterogeneous materials. Testing operations for each sampling station in-
cluded 2 in-place density determinations by the sand volume method and 2
maximum density determinations by the California impact method for each
sand volume test. Analysis of percent relative compaction results for the
3 projects revealed average values of 92.9, 90.5, and 93.6%, with standard
deviations of 2.4, 3.1, and 5.5%, respectively. The greatest dispersion in
results was found to exist for the heterogeneous soils. Factors contribut-
ing to the dispersion of percent compaction were found to be the variation
inherent in the testing procedure, soil, and compaction process. Curves
show comparison of field control test results and randomly sampled test re-
sults. A partial review of problems expected to be encountered in the de-
velopment and use of purely statistical specifications is presented. Has
23 references.

R202465 67A

R202431 67A DESIGN OF PRESTRESSED MULTIBEAM BRIDGES

An analysis is presented of prestressed multibeam bridges consisting of
similar precast beam units placed side by side and connected by shear keys.
The beam units are assumed to be connected by a finite number of hinges.
A FORTRAN IV computer program was developed to determine shears transferred
at the hinges, live load moments and deflections, and dead load moments and
deflections. A prototype bridge and laboratory model bridge with measured
deflections were analyzed and comparisons of the measurements and theoret-
ical deflections are presented. Sample input and output data sheets are
included and the source program listing is given.

<div align="right">R202431 67A</div>

R202433X67A TRANSMISSION TOWER DESIGN GUIDE

An ASCE task committee has developed specific loading recommendations for
self-supporting steel transmission towers. The development of workable and
tested compression formulas for angles based on the yield point of steel is
given considerable attention. Compression formulas illustrated by curves
are developed for 36,000- and 50,000-psi yield steels. Examples showing
slenderness ratio determination and allowable compressive stress for angles
based on yield point are included. Angle width-to-thickness ratio is ac-
knowledged in the development of the formulas, and effects of end connec-
tions are recognized in determining the slenderness ratio. Design formu-
las for compression members, fabrication and testing recommendations,
foundation nomenclatures, survey information, and construction methods also
are included in the report; requirements for the electrical components of
a transmission line (fully covered in the National Electrical Safety Code)
are not included.

<div align="right">R202433X67A</div>

R202459X67A STRUCTURAL MODEL--FABRICATION AND TESTING

Important techniques in structural modeling are reviewed and some of the
limitations imposed by presently available methods are discussed. When
considering the use of structural models, the importance of fabrication,
loading, and instrumentation techniques should be given careful attention.
Final accuracy, costs, and time requirements depend largely on fabrication,
loading, and data acquisition and interpretation procedures; thus, contin-
ued development of improved modeling techniques aims at reproducing and
documenting behavior of the prototype more accurately, economically, or
rapidly. While these are not mutually exclusive, the generally more de-
manding materials, fabrication, and loading requirements for realistic in-
elastic model testing have tended to increase the overall cost and time re-
quirements. These trends tend to restrict application of inelastic models
to broader research and development investigations or design of specific
important structures. Techniques used with elastic models in studies of
service load stresses or strains and elastic buckling investigations, as
well as techniques for inelastic models required in ultimate strength or
collapse load studies, are discussed. Primary attention, however, is given
to inelastic model studies because of recent developments of inelastic and
limit state analyses. Has 36 references.

R202459X67A

Breen, John E
STRUCTURAL MODELS--FABRICATION AND TEST TECHNIQUES
Conf Preprint 472, ASCE Struc Engg Conf, Seattle, Wash, May 1967. U of
Texas, Austin, 29 p, 1 fig, 36 ref
DESCRIPTORS-- *structural models/ *model tests/ *models/ *fabrication/
plastics/ concrete structures/ reinforced concrete/ loads/ static tests/
instrumentation/ deformation/ costs/ scale/ bibliographies/ structural
behavior/ test procedures
IDENTIFIERS-- *elastic models/ dynamic tests

R202461X67A STRUCTURAL MODELS--MATERIALS

A suitable material for structural models, in addition to satisfying the
laws of similitude, should be easily available, easily fabricated, and rel-
atively inexpensive and must possess reproducible mechanical properties and
geometric stability. The most commonly used model materials are plastics,
cementitious materials (unreinforced and reinforced), and metal. If indi-
rect models are to be constructed, any material exhibiting a linear stress-
strain relation is adequate; thus, plastics, because of their low modulus
of elasticity, are used frequently. If direct models are to be used, the
only requirements are linearity of the stress-strain curves of the model
and prototype materials with a constant scale factor and equality of
Poisson's ratio. When models are to be used to determine the elastic and
ultimate strength characteristics of the prototype, all points on the
stress-strain curves of the model and prototype materials must be homolo-
gous up to the failure stress and strain and Poisson's ratio of both mate-
rials must be equal. Materials in common use in the construction of models
are described, and advantages, disadvantages, and limitations are dis-
cussed. Has 36 references.

R202461X67A

Roll, Frederic
STRUCTURAL MODELS--MATERIAL
Conf Preprint 470, ASCE Struc Engg Conf, Seattle, Wash, May 1967. U of
Pennsylvania, Philadelphia, 65 p, 5 fig, 4 tab, 36 ref
DESCRIPTORS-- *structural models/ *models/ *materials/ plastics/ cement/
stress-strain curves/ mortars/ elasticity modulus/ Poisson ratio/ portland
cement/ gypsums/ plasters/ diatomites/ reinforced concrete/ bibliographies/
reinforcing/ concrete/ metals/ structural behavior
IDENTIFIERS-- bond strength/ similitude

STRUCTURAL AND ARCHITECTURAL ENGINEERING

R202467X67A ELECTRIC TRANSMISSION TOWER DESIGN

The design of electric transmission towers is a specialized branch of civil engineering. Procedures and practices peculiar to the design of high-voltage electric transmission towers are presented, and considerations involved in establishing tower configuration and dimensions are set forth. Relative merits of various bracing systems for the tower pedestal are discussed. The author describes the derivation of transverse, vertical, longitudinal, and dead loads for which a tower must be designed, together with their relative effects on overall tower weight. A formula for estimating the dead weight of transmission towers is given, and a stress analysis and summary of a typical 500-kv tower are presented to illustrate the traditional method of tower design. Selection of tower members is discussed. A column curve, in use by the author and substantiated by a number of tower tests, is included. Established tower fabricators now are equipped to test full-size transmission towers. Observation of such a test is a valuable experience for design engineers.

R202467X67A

Marjerrison, Matthew
ELECTRIC TRANSMISSION TOWER DESIGN
Conf Preprint 466, ASCE Struc Engg Conf, Seattle, Wash, May 1967. BPA
Portland, Oreg, 52 p, 13 fig, 1 tab, 6 ref
DESCRIPTORS-- *transmission towers/ steel structures/ stress analysis/ test procedures/ strength of materials/ *structural design/ high strength steel/ economics/ clearances/ *extra high voltage/ maintenance/ ice loads/ wind pressures/ vertical loads/ horizontal loads/ dead loads/ transmission lines/ footings/ electric insulation/ electric cables
IDENTIFIERS-- National Elec Safety Code/ electric conductors/ galloping conductors/ grillage footings/ belled footings/ electrical insulators

WATER RESOURCES

R202439X67A WATER QUALITY CHANGES FROM IMPOUNDMENT

A study of streamflow, turbidity, and coliform organism data from the Iowa River at Iowa City was made over a 15-yr period to determine how impoundment changes water quality and whether present bacteriologic criteria are realistic. The Coralville Flood Control Dam, located about 6 mi above Iowa City, was completed in Sept 1958, making possible a before-and-after water quality data comparison. In addition to functioning as a flood control project, the Coralville impoundment was found to have influenced the downstream water quality of the Iowa River. Turbidity was reduced greatly; coliform density was reduced somewhat, becoming more uniform but remaining generally poor. The bacterial quality of the water exceeded the U S Public Health Service Group IV standard more than half the time. Seasonal differences in water quality remained; however, the impoundment tended to reduce the variation, for example, by distributing poor water from spring runoff over a longer period of time. Streamflow, turbidity, and bacterial density followed the same seasonal pattern. Increases in flow were accompanied by increases in turbidity and bacterial density. During high flows, the extremely high coliform densities were attributed to agricultural land drainage.

R202439X67A

Powell, Marcus P and Berthouex, P M
WATER QUALITY CHANGES DUE TO IMPOUNDMENT
Jour AWWA, Vol 59, No 7, pp 829-834, July 1967. U of Iowa, Iowa City; U of Connecticut, Storrs, 6 p, 3 fig, 1 tab, 3 ref
DESCRIPTORS-- *water quality/ *reservoirs/ *turbidity/ water storage/ water analysis/ *bacteria/ filtration/ water treatment/ water sampling/ sewage effluents/ streamflow/ water pollution/ sewage treatment/ standards
IDENTIFIERS-- *impoundments/ *reservoir storage/ *coliforms/ Iowa River, Iowa/ Iowa

Automatic instruments are valuable and necessary tools for the collection
and analysis of water quality data. Formerly, water quality sampling pro-
grams consisted chiefly of collecting spot samples at selected sites in an
area of study. Such samples, taken on a monthly, weekly, or even a daily
basis, show general long-term trends in water quality but fail to show
short-term fluctuations. Diurnal variations in quality can be caused by
biological activity and sunlight and air temperature variations. Other
cyclic fluctuations can be caused by changing weather conditions, sporadic
discharge of sewage and industrial effluent, and tide stage in areas sub-
ject to tidal influence. This paper describes several automatic monitoring
instruments and discusses their use in the water quality management program
of the Bureau of Reclamation in Region 2.

R202454 67A

Roche, W Martin
THE ROLE OF AUTOMATIC INSTRUMENTATION IN WATER QUALITY MANAGEMENT
Paper, 13th Natl ISA Analysis Instrumentation Symp, Los Angeles, Calif,
May-June 1967. Bureau of Reclamation, Sacramento, Calif, 6 p, 1 fig
DESCRIPTORS-- *water quality/ instrumentation/ automatic/ water analysis/
salinity/ salinity meters/ saline water/ temperature/ recording systems/
*data collection systems/ mobile equipment/ water pollution/ turbidity/ pH/
*water sampling/ dissolved oxygen/ chemical analysis/ water stage
recorders/ electrical conductance
IDENTIFIERS-- *water quality monitors/ *water quality control/ dissolved
solids/ water temperature/ Central Valley Proj, Calif

R202468 67A POTABILITY AND STREAM QUALITY STANDARDS

As a result of public concern regarding water and air pollution, massive
programs are now being conceived and implemented for pollution abatement.
The danger of pollution control agencies imposing unbearable and economi-
cally wasteful restrictions on U S water resources is examined. Treatment
of municipal water at the water treatment plant is assumed to be more eco-
nomical than building sewage plants to improve the raw water. Pollution
abatement is secondary to water treatment insofar as a safe water supply
for a community is concerned. Official criteria for raw water quality are
unnecessary and may even hinder the efficient development of the total re-
source potential of an area. An individual river basin approach policy is
recommended for water resources development.

R202468 67A

Culver, Robert H
INFLUENCE OF STREAM QUALITY STANDARDS ON POTABLE QUALITY
Paper, AWWA Ann Conf, Atlantic City, N J, June 1967. Camp, Dresser &
McKee, Boston, Mass, 11 p
DESCRIPTORS-- water development/ river basin development/ municipal water/
water laws/ water management/ *water pollution/ water requirements/ *water
quality/ pollution abatement/ sewage treatment/ policy matters/ economics/
*standards/ water resources/ water reuse/ water supplies/ water treatment/
*stream pollution/ water demand
IDENTIFIERS-- *potable water/ waste water treatment/ *effect/ water
pollution control

R202469 67A LAKE DESTRATIFICATION BY PUMPING

Artificial destratification of lakes and reservoirs has proved to be effec-
tive in upgrading water quality that has deteriorated because of thermal
stratification. The experiments reported had a 2-fold purpose: (1) to com-
pare mechanical- and diffused-air-pumping methods for artificially destrat-
ifying impoundments, and (2) to determine whether 1 mixing in the late sum-
mer or a series of mixings periodically throughout the season was the bet-
ter method for maintaining good water quality. During 1965, a study lake
was destratified by mechanically pumping water from the bottom and dis-
charging it on the surface for 5 weeks in Aug and Sept. In 1966 a
diffused-air-pumping system was used for mixing a study lake 4 times peri-
odically throughout the season; a second study lake was mixed 5 times
using the same method. On the basis of oxygenation capacity and destrati-
fication efficiency, the diffused-air-pumping system apparently worked
better and was easier to install and operate than the mechanical-pumping
system. Effects on dissolved oxygen, nitrogen, phosphorus, iron, manga-
nese, sulphides, algal growth, and algae are described. Has 19 references.
                                                           R202469 67A
Symons, James M; Irwin, William H; Robinson, Ernest L; Robeck, Gordon G
IMPOUNDMENT DESTRATIFICATION FOR RAW WATER QUALITY CONTROL USING EITHER
MECHANICAL- OR DIFFUSED-AIR-PUMPING. Paper, 87th Ann Conf of AWWA,
Atlantic City, N J, June 1967. FWPCA, Cincinnati, Ohio, 57 p, 20 fig,
5 tab, 19 ref
DESCRIPTORS-- *aeration/ *reservoirs/ air/ *lakes/ bibliographies/ mixing/
diffusion/ water quality/ *dissolved oxygen/ nitrogen/ algae/ temperature/
mixers/ plankton/ phosphorus/ oxidation/ limnology
IDENTIFIERS-- *destratification /thermal// *reaeration/ *pumping/ *diffused
air pumping system/ thermal stratification/ impoundments/ *oxygenation/
nutrients

NUMERICAL INDEX

Volume 1, Number 1